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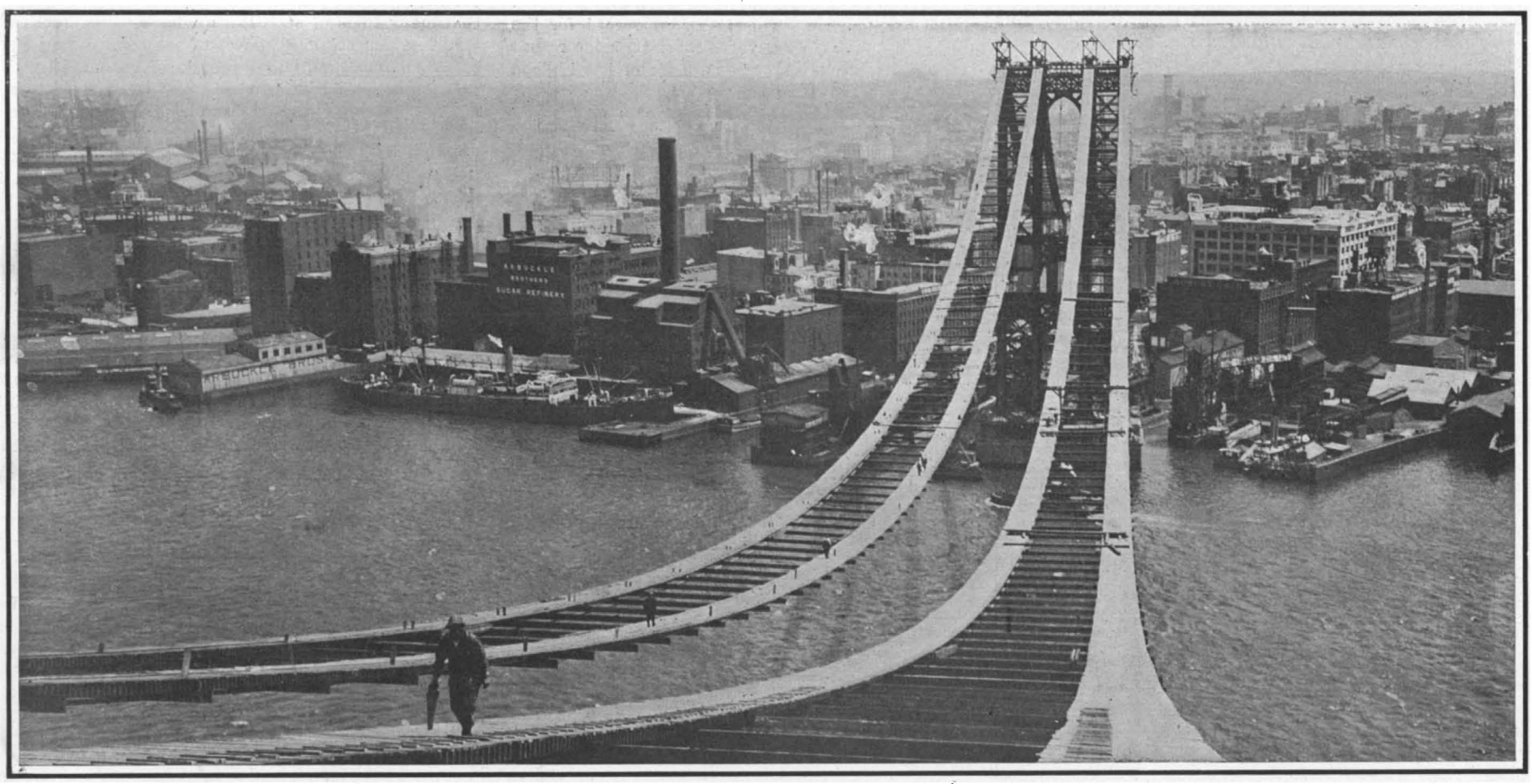
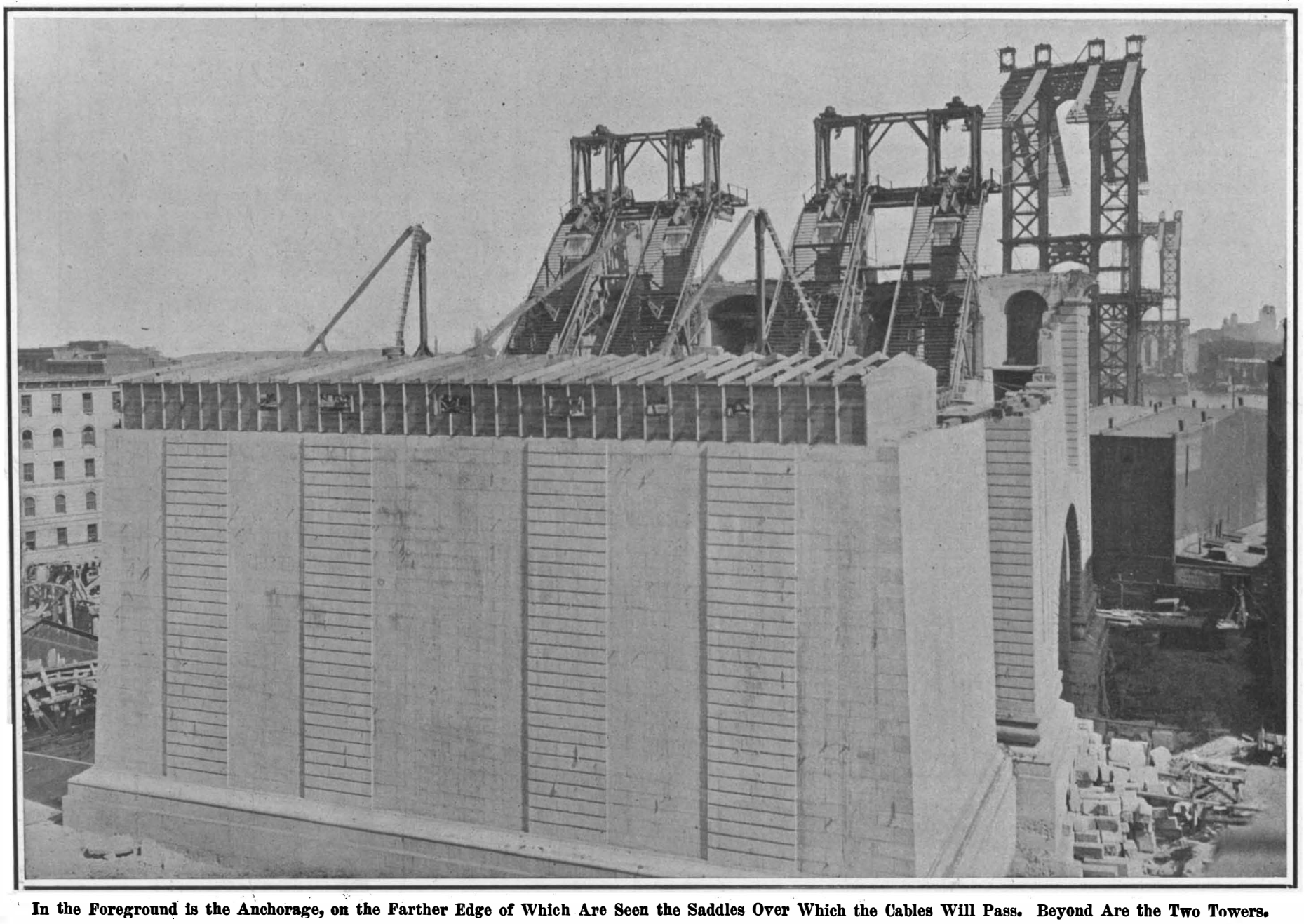
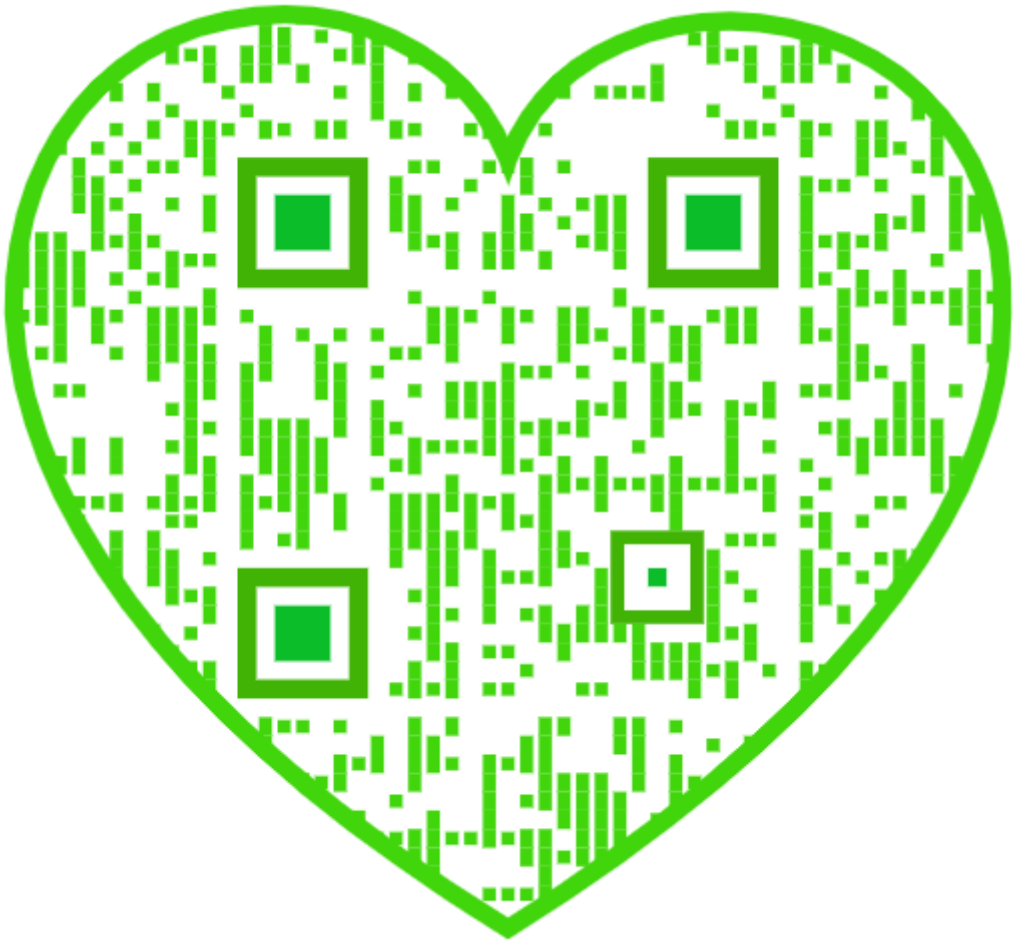


View from the Top of Manhattan Tower, Looking East, Showing the Footways for Constructing the Cables.



In the Foreground is the Anchorage, on the Farther Edge of Which Are Seen the Saddles Over Which the Cables Will Pass. Beyond Are the Two Towers.

BUILDING THE FOOTWAYS FOR THE STRINGING OF THE MANHATTAN BRIDGE CABLES.—[See page 76.]



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NEW YORK, SATURDAY, AUGUST 1, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE POLLUTION OF NEW YORK HARBOR.

The incumbency of his distinguished office by Mayor McClellan will be notable for the important public works inaugurated during his administration which have to do with that most important of all civic interests, the health of the inhabitants. The construction of the Catskill water supply is due largely to the wisdom and persistence of the mayor; and we are glad to note that he is now interesting himself in another sanitary question which has long been pressing for serious consideration. We refer to the pollution of New York harbor, which has been allowed to increase to a point at which there is a loud call for thorough investigation, to determine just what the extent of this evil is at the present time. The matter has been under discussion in a more or less desultory way for many years, and for some time there has been in existence what is known as the Metropolitan Sewerage Commission; but so many contrary opinions were held by the members as to the actual extent of the pollution and the proper remedial measures to be undertaken, that the mayor decided upon a change in personnel and a thorough reorganization. New York bay and harbor represent, it is true, a large body of water; but the growth of population around its shores has been so rapid that it is quite a question whether the bay is not receiving more sewage than it can properly dispose of. Moreover, the problem has been rendered more serious by the proposal to discharge into the bay the sewage of the manufacturing towns which lie in the Passaic valley. Ultimately the question is likely to become the subject of litigation; and, in view of this, it is desirable that exact figures should be available as to the amount of sewage now emptied into these waters. The famous litigation between the cities of St. Louis and Chicago over the question of the pollution of the Mississippi by the drainage from the Chicago Canal showed the necessity for the possession of ample statistical data; and it is felt that the exact determination of conditions in New York harbor cannot be too quickly arrived at.

GOOD WORK IN THE RAINY SEASON AT PANAMA.

The bulk of the material which is being excavated at Panama is of a character which renders it particularly susceptible to the disintegrating influences of rainy weather. It loses its consistency and becomes more or less "greasy," with the result that it has been exceedingly difficult to keep the tracks in the Culebra Cut, and those over which the excavated material has to be hauled for many miles to the dumps, in proper line and level. Unless constant vigilance is exercised in maintaining the tracks, trains are liable to derailment, and the whole traffic of the line on which the mishap occurs may be held up for a considerable period. In the earlier attempts to construct the canal, the falling off in the amount of excavation in the rainy season was very great; but under the present excellent administration, and thanks to the highly-skilled corps of engineers and foremen, the difficulties have been mastered. There is, of course, a reduction in the total output of this time of the year, but the rate of excavation per month is still maintained at a high figure. Thus, the total excavation on all the divisions of the canal during the month of May was 2,702,897 cubic yards; and although, compared with the previous month, the total amount of excavation was 593,200 cubic yards less, it must be remembered that the mean rainfall was 12.8 inches greater. The total amount excavated from the canal prism in May was 2,525,887 cubic yards. Comparing this with the amount taken out in May, 1907, the total excavation this year is 1,685,238 cubic yards greater, and this in spite of the fact that the mean rainfall for May of this year was 14.7 inches, or 7.6 inches greater than during May of last year. Again, the total excavation in the Culebra division during the month was 960,840 cubic yards. This is a decrease of 281,734 cubic yards, as compared with the amount excavated in April; but compared with the work done during May, 1907, the excavation by steam shovels in the Culebra division was 39 per cent greater, and the average output per shovel per day was about 10 per cent greater, and this in spite of the fact that the rainfall in May, 1908, was about 52 per cent greater than in May, 1907.

For the month of June the results are even more creditable, the grand total of excavation being 3,060,307 cubic yards, of which all but 165,316 yards was taken from the canal prism. This is a new record for the rainy season, being 356,384 yards more than the record for May, and only 419,963 yards short of the highest dry season record, that of March, 1908.

MORE DAYLIGHT FOR RECREATION.

It is not often that a measure of such a startling character as the Daylight Saving Bill is introduced into the English House of Commons. The fact that the momentous changes advocated by the bill are proposed by William Willett, a member of the Royal Astronomical Society, suggests that the measure may not be so chimerical as might be supposed. Naturally, the first dispatches relating to the subject were somewhat incomplete, and have led to not a little misunderstanding, both as to the aims of the measure and the manner in which its provisions are to be carried out. Later advices giving fuller particulars show that it is proposed during part of the spring and autumn, and the whole of the summer, to advance the clocks throughout the whole country, moving the working day forward, with a view to including within the working hours a longer stretch of daylight. The change is to be made gradually. At 2 o'clock on the morning of each Sunday in April the clocks would be set forward twenty minutes, the result of which would be that during the first week of April the workingman who usually rose at 6 o'clock would actually rise at 5:40 A. M.; and instead of quitting his work at 5 P. M., he would actually leave at 4:40. During the second week of the month, although he rose by the clock at 6 A. M., by the sun he would rise at 5:20 A. M., leaving his work at 4:20 P. M. During the last week of the month he would rise at 4:40 A. M. by the sun, though still by the clock at 6, and his work would be over by 3:40 P. M. Mr. Willett believes that the change would be sufficiently gradual to prevent its being apparent, or causing any physical or other inconvenience. The total amount of daylight saved in the mean latitude of England would be in April, 23 hours; in May, June, July, and August, 164 hours; and in September, 23 hours—a total for the six months of 210 hours. Among the commercial advantages urged in favor of the change is that railroads, factories, and commercial houses which are large users of gas and other artificial light, would realize a saving by these additional nine whole days of daylight of $15,000,000; whereas as against the change it is urged that it would completely disorganize the railroad service of the country, besides causing various commercial and other complications of a troublesome character.

To the average individual, however, the most attractive feature of the proposed change is that it would greatly lengthen the spring, fall, and summer evenings, and afford a long stretch of daylight for recreation during the most pleasant period of the twenty-four hours. Visitors who have sojourned for any length of time in England or in continental countries in the same or higher latitudes, have appreciated the long duration of twilight during the summer months, darkness not setting in during the longest days until from 10 o'clock P. M. to midnight. In the more southerly latitude of the United States, the path of the sun across the zone of twilight being less oblique than in the latitude of the British Isles, the period of twilight is much shorter; with the result that even on the longest day of the year, darkness sets in soon after 8 o'clock. Consequently, the period of recreation between dinner and dark is so short, that there are certain forms of outdoor recreation in which it is not worth while to engage. The advancing of the clock by one hour and twenty minutes, however, would render the spring, summer, and autumn evenings the choicest of all periods of recreation, the sun being low and the temperature moderate. It has been uggested that, in view of the delightful conditions which characterize our so-called Indian summer, it would be advisable, should any such change ever be contemplated in this country, to restrict it to the four months from August to November inclusive. The advantage of a long daylight evening for such sports as yachting, rowing, golf, tennis, and automobiling are indisputable.

After all said and done, however, whether the English measure be passed or not, it is unlikely that any daylight bill of this kind will be introduced into the United States, at least for many decades to come. Tradition, habit, and a hundred settled usages, national, commercial, and domestic, will always be ready with a strong protest against any interference with that symbol of unchanging order, the clock.

RELATION OF THE GAS PRODUCER TO LOW-GRADE FUELS.

In a recent letter of the Secretary of the Interior to the Senate, transmitting the results of investigations by the government of the fuels of the United States, certain important facts relating to tests made with low-grade fuels in gas producers are related, which have an important bearing upon the question of the conservation of the mineral resources of the country. The report says that the tests have shown that many fuels of such low grade as to be practically valueless for steam furnace purposes, including slack coal, bone coal, and lignite, may be economically converted into producer gas, and may thus generate sufficient power to render them of high commercial value. Coal as high as 45 per cent ash, and lignites and peats high in moisture, have been successfully converted into producer gas, which has been used in operating gas engines. It has been estimated that on an average there was developed from each coal tested in the gas producer plant two and one-half times the power developed when used in the ordinary steam boiler plant, and that relative efficiencies will probably hold good for the average plant of moderate power capacity, though this ratio may be greatly reduced in large steam plants of most modern type.

It was found that the low-grade lignites of North Dakota developed as much power when converted into producer gas as did the best West Virginia bituminous coals when utilized under the steam boiler. In this way lignite beds underlying from 20,000,000 to 30,000,000 acres of public lands, supposed to have little or no commercial value, are shown to have a large value for power development. This is of importance to the West and makes possible a great industrial development there.

In the fuel-testing plant, with the best Kanawha Valley coal, the steam plant produced 0.28 horse-power per pound of coal per hour, and the gas producer 0.96 horse-power, or 3.43 times the efficiency for the producer gas plant over the steam plant. The remarkable feature in these tests was the comparison between the Kanawha Valley coal under the steam boiler and the lignite in the producer gas plant. The former under the boiler produced 0.28 horse-power per hour, while the lignite produced 0.30 horse-power per hour when operated in the producer gas plant, or 1.07 times the power of the best steam coal burned in a boiler furnace.

It became evident early in the fuel investigations that the greatest possible saving and consequent prolongation of the life of the fuel resources of the country might be had through a more rational utilization of the low-grade fuels. In the bituminous coal fields, especially in the Middle West and Southwest, where the coals are poor, the coal bed may run but 2 or 3 feet of good merchantable steam coal, but to mine this the entries and drifts must be opened to a height of 6 feet. This means that from 2 to 4 feet of material, even containing quite a quantity of medium grade coal, is thrown on the dump heap. Means of burning the whole coal as mined, or of burning the "bone" coal alone, may be devised which will make the entire product mined of value for heating and power purposes.

A NEW PROCESS FOR THE MANUFACTURE OF COPPER WIRE.

A new process for the manufacture of copper wire in one operation from crude copper, such as Bessemerized copper bars, has been perfected by Mr. Sherard Cowper-Coles of London. The scope of the invention is the electro-deposition of the copper on a revolving mandrel or drum running at a critical speed, this latter having been determined by rotating a cathode in the form of a cone, that portion which gave the smoothest and toughest deposit being the critical speed for the conditions under which the copper was deposited. Very dense copper is produced by this means, which has a considerably higher tensile strength than that obtained by the orthodox process of annealing and drawing or rolling.

The theory of the process is that each molecule of copper as electro-deposited is burnished or rubbed by the friction of the electrolyte on the mandrel, insuring a more homogeneous metal than is possible by applying great pressure to a large mass of metal by swaging, rolling, or drawing.

Copper so electro-deposited crystallizes at right angles to the surface on which it is deposited; this fact has been turned to account by making a spiral scratch which must be V-shaped on the mandrel, so as to cause the crystals to make a weak line of cleavage. If the scratch is rounded at the base the crystals form radially, and no weak line of cleavage is produced. Four or five miles can be made on a mandrel. The strip is unwound and passed through a set of dies to remove the burr or fin and to form a round section.

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH.D.

The evening skies, which for a long time past have been brightened by the presence of one or more of the planets, now lose them for a time. Mercury, Mars, and Jupiter are all behind the sun this month, and we cannot see them. Venus is a morning star and Saturn does not rise till late in the evening. Only the distant Uranus—to the naked eye a mere speck of light just seen on the darkest night—is in sight when the night begins.

We will none the less find much of interest in the starry heavens.

Looking south, we see the outlines of Scorpio and Sagittarius, which are never better seen than at this time. Above them, along the Milky Way, are the constellations of which we also spoke last month. Aquila, with the bright star Altair, the small groups Sagitta and Delphinus, that splendid constellation Cygnus, and right overhead Lyra, with the steel-blue Vega, Cepheus, and Cassiopeia, are in the northeast. The blank space below the pole contains the modern constellation Camelopardus (the Giraffe), one of those introduced in the sixteenth century by the astronomer Hevelius, to fill the gaps between the ancient and conspicuous ones. The Little Bear and the Dragon are above the pole, the latter reaching almost to the zenith. The Great Bear fills up most of the northwestern sky. The three pairs of stars which mark the paws are almost setting.

Leo is almost gone, and Virgo follows him below the horizon. The great red star almost due west is Arcturus. His neighbors in the constellation, Boötes, are above him. The Crown (Corona) and Hercules lie on the line between Arcturus and Vega. In the latter constellation, about one-third of the way from the star η toward ζ, the naked eye sees a speck, which a field-glass shows as a fuzzy spot, with two small stars near it. A telescope of moderate power reveals that this patch of light is a "globular cluster" of faint stars. There are thousands of them densely crowded at the center and thinning out at the edge.

Many such clusters are known and catalogued, but this is the finest one visible in our latitude. Two, both far in the southern hemisphere, surpass it.

How large the stars in such a cluster really are we do not know, much less how they came to flock together as they do. But of one thing we may be sure. The aspect of the heavens as seen from one of the stars in such a cluster, or from a planet revolving about it, would be far more brilliant than our own. From a star in the middle of the great cluster in Hercules, at which we have been looking, even the fainter and more distant stars of the cluster would look as bright as the brightest stars do to us, while the nearer ones would be brighter still. The heavens would appear studded with thousands of brilliant stars among which it would be a hard task for science to pick out the few that did not belong to the cluster, but were really far outside.

An observer at the edge of the cluster would see a yet stranger sight. One-half of the heavens—on the side where the center of the cluster lay—would be nearly blank in comparison, though even there the few outliers of the cluster, being relatively so near, would probably contribute more conspicuous stars than all the universe beyond them.

South of Hercules we find Ophiuchus and Serpens, as our map shows. Along the eastern horizon we see a new set of constellations which have just risen. Capricornus is farthest to the right, about due southeast. Then comes Aquarius, whose most easily recognized figure is a little group shaped like a Y lying on its side. The star ζ shown on the map, is at the fork.

Next comes Pegasus, the familiar "great square" standing on one corner. North of this is Andromeda, still very low down. The great nebula, which is easily visible to the naked eye, can be found with the aid of the map.

The planet Saturn rises almost exactly due east about half an hour after the time for which our map is drawn.

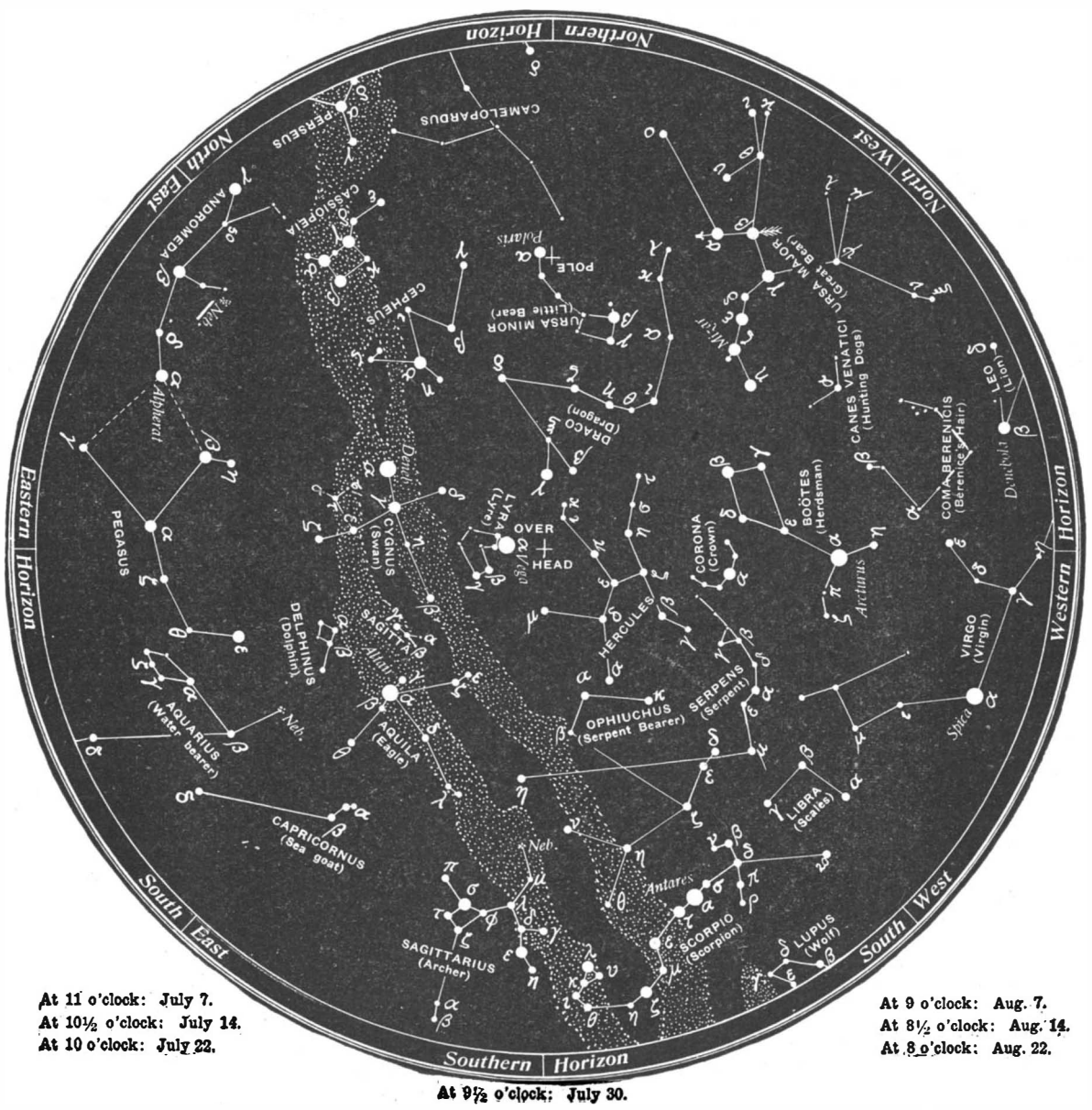
THE PLANETS.

Mercury is morning star till the 20th, when he passes behind the sun, and is thereafter evening star. He is visible only during the first week in the month, when he rises a little before 4 A. M. At this time he is in Gemini south of the stars Castor and Pollux.

Venus is morning star and reaches her greatest brilliancy on the 11th. She is also in Gemini and is exceedingly conspicuous, rising before 2 A. M. for most of the month.

Mars is in conjunction with the sun on the 22d, and is practically invisible all through August. Jupiter is also in conjunction on the 17th, and the same remark applies to him.

Saturn is in Pisces and rises at 9 P. M. in the middle of the month. Uranus is in Sagittarius a little southeast of the star π shown on the map. In looking for it care must be taken not to take one of the two conspicuous naked-eye stars east of π for the planet. The latter is below these two and much fainter than either. Its slow eastward motion relative to the stars will make its identity sure. It can barely be seen with the naked eye even under the best conditions, and to *observe* its position a field glass is necessary. Neptune is in Gemini and comes to the meridian about 3 A. M.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.

At 9½ o'clock: July 30.

At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

NIGHT SKY: JULY AND AUGUST

THE MOON.

First quarter occurs at 5 A. M. on August 5, full moon at midnight on the 11th, last quarter at 4 P. M. on the 18th, and new moon at 6 P. M. on the 26th. The moon is nearest us on the 12th, and farthest away on the 26th. She is in conjunction with Uranus on the 9th, Saturn on the 15th, Venus and Neptune on the 22d, Jupiter and Mars on the 26th, and Mercury on the 27th. Of the visible conjunctions, none is close.

Princeton University Observatory.

The new rail specifications of the Pennsylvania Railroad contain one requirement which should result in some decidedly interesting information concerning the cause of failures of rails in service. This is the marking of each rail with a letter indicating the portion of the ingot from which it came. It has been found by the Philadelphia and Reading Railway that two-thirds of all the rails which fail are rolled from the top of the ingot, and the next largest percentage of failures is among the rails from the bottom of the ingot.

IMMORTALITY OF MICRO-ORGANISMS.

A problem far more intensely discussed by modern scientists than the immortality of the soul is the immortality of certain micro-organisms, viz., the lowest of all living creatures, which are constituted by a single cell.

As pointed out by G. Katsch (Der Zeitgeist, Berlin, April 27, 1908) this problem was first enunciated by Weissmann in 1882, in the following manner:

Single-cell organisms are not subject to natural death. Endowed with the capacity of multiplying unceasingly by subdivision they may be called immortal. Multicellular organisms, on the other hand, being subject to decay after a given period, are mortal. This at first sight appears quite plausible. If, in fact, a small amœba be taken to surroundings in which it is sure to find some nutritive substance, and in which it is protected against any noxious influences which may result in a violent death, it will never be seen to die, even after a considerable length of time. However, the nucleus, after some time, will lengthen and narrow at its middle, and eventually will subdivide into two parts, while the surrounding protoplasma will likewise separate into two parts, each of which will receive one-half of the nucleus, so that two amœbæ will exist in the place of one. This process of multiplication under favorable conditions will go on indefinitely, and so far from being any decay, life will be multiplied.

Although multicellular organisms may thus wear out, like machines, in order eventually to die, there is only a violent death possible in the case of amœbæ or protists, each of which thus in a certain sense continues its life from the primeval times at which its species has sprung up, onward. Nor should it be objected that life being characterized by an exchange of matter, it is not the same substance whose life has been maintained for thousands of years. The renewal of substance, in fact, goes on very gradually, so that there is a material continuity of organism which in spite of an eventual complete renewal still remains unaltered, just as the population of a city, while being gradually renewed entirely, yet maintains itself. However, this problem may as well be considered from another point of view. Supposing the amœba to be subdivided into two identical daughter cells; it is impossible to ascertain in which of these the original amœba is continuing its life. It would be absurd to assert that the individual is continued in both self-contained beings. A similar puzzle is met in connection with certain inferior animals, such as earthworms and polyps, which can be subdivided by simply severing their bodies. It would be feasible to attribute to each of the daughter amœbæ half of the individuality of the mother cell, as each new generation of amœbæ would then constitute an ever smaller fraction of the individuality of the original amœba. In fact, it would be far more rational to suppose that while there is no death, the end of the individual is determined by its subdivision, each of its products being a new individual, which continues the existence but not the individuality of the former.

Covering Material for Steam Pipes.—Rice flour, rye flour, cow hair, and beet-root molasses of each 1 part boiled with 300 parts of water and gradually stirring the while, 86 parts of fossil meal (kieselguhr) added. The mass is applied in several layers so that at last a coating 1¼ inches thick is formed on the luke-warm pipes. The weight of a quantity sufficient for a surface of 40 inches square would be about 13 pounds, after drying 3 pounds. The paste sold under the name of "steam economy" consists of 450 parts water, 40 parts of clay, 78 parts of fossil meal, 14 parts of cow hair, 7 parts linseed oil, 7 parts rye flour, 5 parts beet-root molasses.

SOME HOME-MADE WEATHER INSTRUMENTS.

BY S. LEONARD BASTIN.

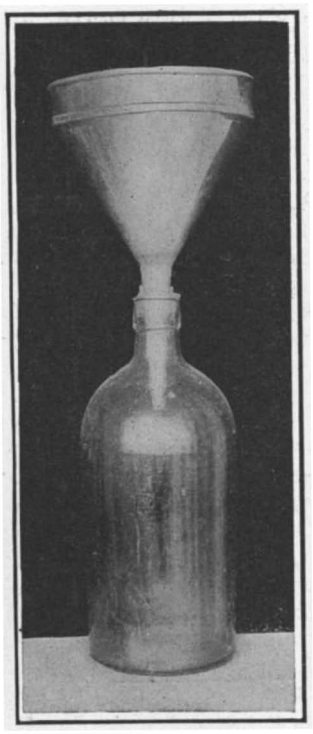
There is no gainsaying the fact that fishermen and those who spend a great deal of their time in the open air become very skillful weather prophets without the aid of any instruments at all. For ordinary folk, however, it is most desirable to acquire a few of the more simple weather contrivances by means of which it is possible to discover the prevailing conditions. It is a very easy matter to construct these devices, and one which anybody of average ability can undertake. Not a few of the aids to weather lore which are mentioned in the present paper have been accredited by meteorological experts, and many are of real value in the study of this important science.

One of the earliest principles in meteorology is the determination of the amount of moisture in the atmosphere. To arrive at an exact estimate is of course only possible with the help of the hygrometer—an instrument of a rather elaborate nature. But there are many devices by means of which changes in the moistness of the air may be shown, some of them exceedingly easy to arrange. Perhaps the simplest form of all, known to every housewife in the coast towns, is the suspended piece of seaweed. Any kind of the common brown algæ answers the purpose admirably. A small bunch tied together and hung up on a wall shows the excessive humidity in the atmosphere which often precedes rain by becoming damp and flabby.

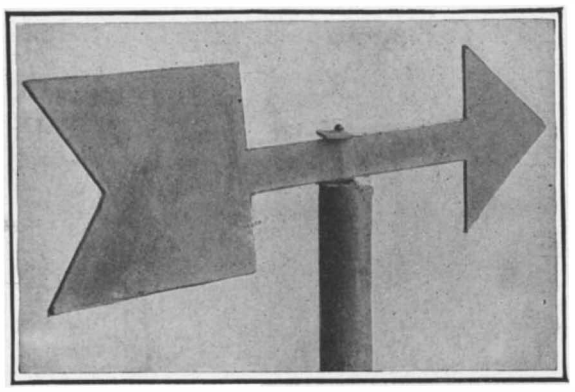
A very ingenious contrivance is the old-fashioned "weather house," largely made in Switzerland. It is arranged in such a way that two figures act in response to the twisting of a piece of catgut. The material, supported by a wire, controls the movements of a little platform on either end of which is placed a model. Excessive moisture in the air causes the catgut to twist, and turn the platform round, so that the man emerges from one of the doors in the front of the house. Reverse conditions of the atmosphere bring about the contraction of the catgut, and the platform swings back, thus bringing the figure of the woman into prominence at her particular door. The making of a weather house is quite a simple affair and how to set about the construction may be judged from the picture giving a "peep behind the scenes." If properly made the contrivance is a fairly reliable weather prophet.

In the study of the weather it is very important to be able to register the constant changes which take place in the weight of the atmosphere. Air is light or under low pressure at a storm center and the winds blow toward the low pressure center from the high pressure areas. To indicate variations in the weight of the air the barometer was designed, and as its movements have a most important bearing upon coming weather some kind of a "glass" is a necessity. An interesting device not uncommonly to be seen in country places is the water barometer. It is composed of a two-pound glass jar and a glass oil flask. The jar is about half filled with water, and the flask put head downward into the liquid. Placed in a shady position, where the temperature is fairly even, it will be observed that the height of the water in the neck of the flask is constantly varying—in fact it is acting on the same lines as the more elaborate barometer. In order to obtain some idea as to the movement of the water, it is a good plan to mark the stem of the flask off into tenths of an inch. This may be accomplished by means of a glass cutter, scratching the lines as regularly as possible round the neck. A little experience will soon teach the owner as to how much importance to attach to the movement of the water barometer. However, a decided rise is a good sign of fine weather, while when the water is low down in the tube stormy weather may be expected. Various kinds of storm glasses have been constructed from time to time to indicate a generally disturbed condition of the atmosphere. One of these has long been recognized by experts as of real value to the meteorologist. It is composed of a glass tube, say, about nine inches in length and closed entirely at one end. Fill this with a mixture of 2½ drachms of camphor, 38 grains of niter, and 38 grains of salammoniac; all to be dissolved in 9 drachms of alcohol and 11 drachms of water. Of course any chemist would supply this mixture to order. When the material is obtained, carefully fill the tube with it. The open end of the tube must now be stoppered with a cork, and over this stretch a piece of parchment and firmly tie this down. Now with a large needle pierce a hole through the cork, so that there will be a certain admission of air to the contents of the tube. The tube should be put into a case, and the sides marked off in the manner indicated in an accompanying illustration. A close watching of this instrument will soon acquaint the observer with the significance of the appearance of the material. In fine weather the curious feathery look is much restricted, but as a change is about to take place the formation will spread upward, entirely occupying the whole of the tube if the conditions are likely to be very stormy.

A Curious Frog Weather Glass.



A Home-Made Rain Gage.



A Simple Weathervane.

A few leeches kept in a covered jar of fresh water are said to be interesting indicators of weather to come. During calm, still conditions, the creatures will remain in a quiescent stage, but at the approach of rain or wind this will be much altered. The leeches become exceedingly restless, and move about with curious jerks as if they experienced an uneasy sensation. The frog is said to be a weather prophet, too. Fill a jar about half way up with water, and place a small frog inside. Set in the jar a small wooden ladder, which will project several rounds above the level of the water. In fine weather the frog will clamber up the ladder out of the water, while at the approach of less settled conditions, it will retire beneath the surface.

In the preparation of any forecast, the quarter from which the wind is blowing must always be taken into consideration. There is no better evidence of the direction from which the wind is blowing than a smoking chimney. However, if a fairly elevated position is available, a weather vane may be used. It is essential that the device be put in a fairly exposed place, as its movements will be rendered unreliable if the breeze be made to eddy by local obstructions. A simple vane may be sawed out of a single piece of wood with a fret-saw. The best plan is to procure a slab of wood free from knots, and about a quarter of an inch in thickness, twelve inches wide, and eighteen inches long. When the arrow has been cut out it should be smoothed down and given two or three coats of paint. At the point of balance pierce a hole through the shaft of the arrow. The vane may be balanced by cutting a deep V in the rear end and by weighting the point with sheet lead. Cut two pieces of sheet metal to act as "washers" for the top and bottom of the shaft and then pivot the vane to the top of a broomstick with a straight wire nail. A touch of oil to insure that the vane revolves quite easily, and the home-made article is practically complete. The weather vane may now be fixed up on the top of a garden house or barn.

A very important part of weather observation consists in keeping a record of the amount of rainfall in a certain locality. It is not a very formidable matter to construct a rain gage, which would answer all reasonable requirements.

Obtain a metal funnel, which should be five inches in diameter. This should be made of copper, or if a tin article only is available, the metal should be carefully painted so as to prevent rust. Next get a glass bottle which shall hold about a quart, the mouth of which is about an inch across. The lower part of the funnel should fit well down into the neck of the bottle, so that there is no space between the sides. To make a better joint it is just as well to introduce a ring of rubber, first stretching the material round the tube of the funnel, and then placing the latter in the bottle. It is essential to buy a measuring glass, and when doing so to state the diameter of the opening which will collect the rain. The glasses are specially worked out for the purpose, and usually measure down to the hundredths of an inch. The rain gage when completed should be placed in as open a position as far as possible away from any trees or buildings. In order to make it secure against being overthrown by a rough wind, it is as well to bury the lower part of the bottle in a hole in the ground, of course in such a way that it may be freely removed when the daily measurement of rainfall is taken.

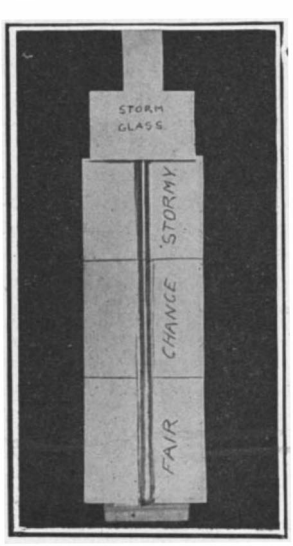
The Water Barometer.

Rear View.

The Weather House.

Front View.

The Seaweed Hygroscope.



A Weather Glass.

SOME HOME-MADE WEATHER INSTRUMENTS.

IRRIGATION OF THE YUMA VALLEY.

BY DAY ALLEN WILLEY.

One of the most important and interesting projects connected with the reclamation of arid territory in the Southwest is technically known as the Yuma project, as it is intended to irrigate an extensive territory located in the Yuma Valley and bottom lands adjacent to the Colorado and Gila rivers in the States of California and Arizona. As is well known, the Colorado forms the western boundary of Arizona and a portion of the southern boundary of California. The Gila River enters it from the east a short distance from the town of Yuma in the extreme southwestern corner of Arizona. These two watercourses provide an abundant supply for the area to be irrigated, which for the present will comprise about 100,000 acres. The topography of the country and its formation make the work of constructing dams, canals, and suitable storage reservoirs unusually difficult. There is no natural formation of which engineers can take advantage, as in many other portions of the West, where nature has thrown up rock walls which can be utilized in storing the water supply. As readers of the SCIENTIFIC AMERICAN are well aware, the Colorado has for years been forming a bed for itself, annually carrying down an immense amount of silt in solution, which is deposited along its course. The channel of the Gila is somewhat similar to the Colorado, and this stream also is subject to very sudden and extreme changes in the volume of water, so that especial care must be taken to protect irrigation works against floods.

Reversed Abatis. Note Accumulation of Drittwood.

Construction of Brush Fencing and Matting.

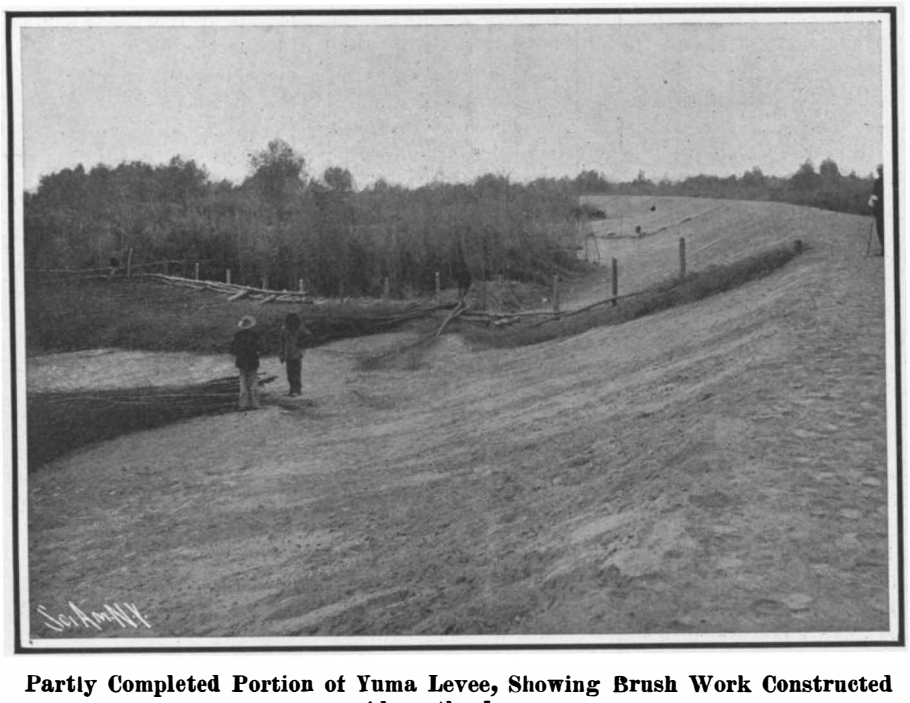
When the question of irrigating these bottom lands of California and Arizona was considered in 1904, the engineers of the Bureau of Reclamation decided that the best way to construct permanent works would be to erect a diversion dam across the Colorado River at a point below where the Gila flows into it. It would be necessary, however, in the opinion of the engineers, to have elaborate protection for the dam, and embankments large enough and of sufficient strength to confine the waters of the rivers when in flood. The problem to be solved was how to secure a foundation for the levees and other works, and a form of protection against the flood waters which would prevent the barriers from being badly damaged if not entirely washed away by the flood currents. The plan adopted was decidedly unique from an engineering standpoint, as it was decided to depend upon earthworks guarded by wooden dams or abatises to check the flow of water against them. When it is stated that the levees considered necessary will when completed extend a distance of nearly 75 miles on the Colorado and Gila rivers, an idea of the magnitude of this work alone can be gained.

The diversion dam or Laguna dam, as it is called, will extend for a distance of 4,780 feet across the Colorado at a point 12 miles from the town of Yuma. Owing to the friable foundation of the river channel, the dam is of enormous width in proportion to its other dimensions, being 267 feet wide on the bottom, although but 19 feet in height. It will require 356,000 cubic yards of concrete to complete, and have a displacement in the water equal to the weight of 600,000 tons. This may be called the main work, and it is about two-thirds completed at the time of writing. Before work was begun, however, it was necessary to build a very extensive coffer dam as well as other temporary barriers to drain the river bed, so that a foundation could be laid. Work was also begun upon the levee protections referred to, until the construction has reached such a point that it has been thoroughly tested by exposure to flood currents, with the result that no damage of importance has been done to either the concrete structure or the protecting banks.

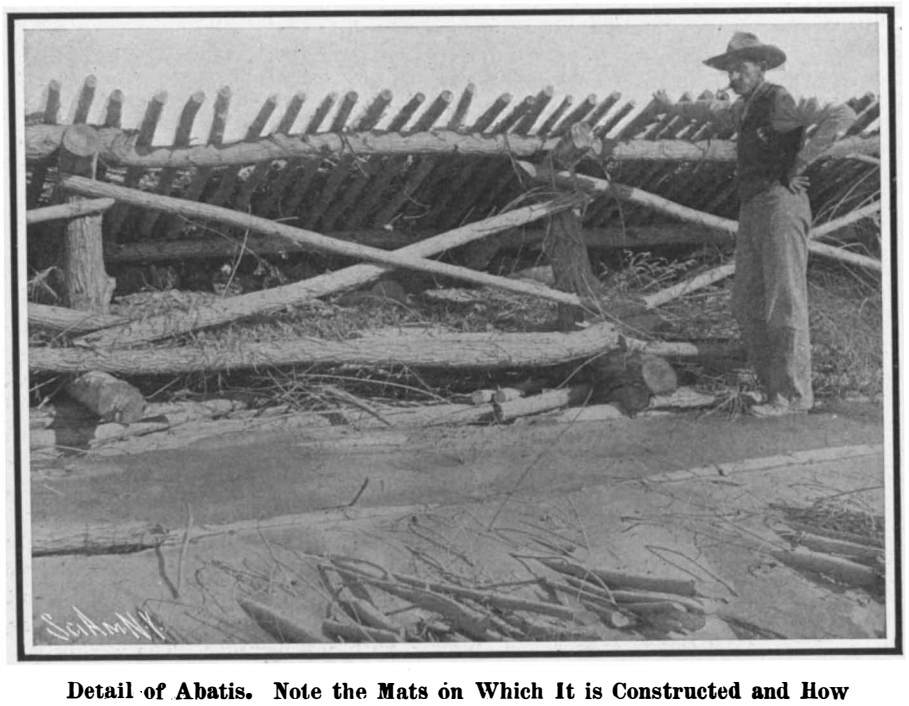
The extensive mileage of levees is partly necessary to protect the main irrigating canals, of which there will be one on each side of the Colorado. The canal on the Arizona side will be 16 miles in length, the one on the Colorado side 10 miles in length, making a total of 26 miles and serving 138 miles of laterals, by which the water will be distributed over the bottoms. The water will enter the canals through gates, while pumping machinery will be installed at several points, where it will be necessary to raise the water supply to a higher level to serve the laterals. It is calculated that the dam, which is the only one of its kind in this country, will be of sufficient capacity to fill the main storage reservoir, which will have an area of 10 square miles. The dam is known as an India weir dam, being of a design which has been very successfully employed in East Indian irrigation, where it is usually constructed of wood.

In building the dikes or levees, much of the labor is done by scrapers and plows drawn by horses, as the soil being stoneless and soft can easily be heaped up and graded to the proper level. The work of building these levees is quite similar to the artificial embankments formed to restrain rivers in the South, the width at the bottom usually being several times the width at the top, although the crest of the embankments is ample to permit the building of railway tracks here and there, thus using it as a roadway. As the quantity of concrete required would be so great that it would be far too expensive to use in protecting the levees, and deposits of natural stone are too far distant to be employed, the main defense of the levees against the flood currents, as already stated, is woodwork in some form. This is obtained from timber tracts in the vicinity. Young trees are used extensively, the trunks being cut into suitable lengths, and used for the foundation of the matting or abatis. This foundation is fastened securely together, and upon it laid smaller limbs, their ends pointing up and down stream like the fascines of ancient fortifications. Bunches of brushwood and

Teams at Work on the Yuma Levee.



Partly Completed Portion of Yuma Levee, Showing Brush Work Constructed Along the Levee.

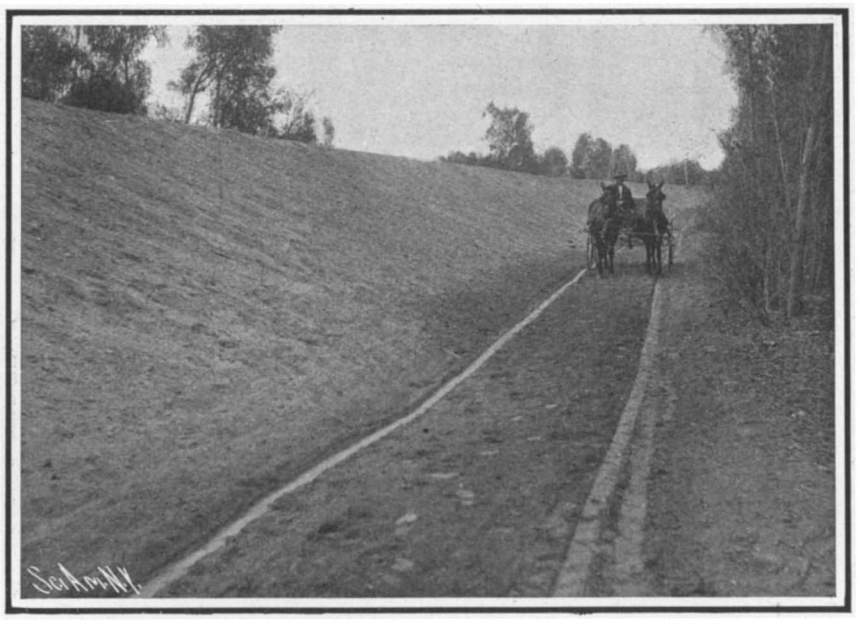


Detail of Abatis. Note the Mats on Which It is Constructed and How Framework is Fastened Together.

shrubbery form the next layer, being worked in among the boughs beneath. In another form of wooden framework, posts are driven into the earth deep enough to secure a firm foundation, in which they hold rigidly. Then a sort of fence is made by nailing limbs of trees from post to post. The face of this fence is further protected by driving piles into the earth in front of its upstream face. Both in the front and rear of the fence are arranged layers of boughs and brushwood, sometimes covered over with earth and sometimes left bare.

These dikes are intended not only to protect the embankments, but to be land makers. Each extends outward from the levee a certain distance into the river channel, but at such an angle that it will catch driftwood and other flotsam which may come down the stream. This material will be piled against it, and as the mass enlarges, it will constitute a stronger barrier against the flood. The idea is similar in some respects to the jetties which have been constructed at various points on the Mississippi, not only to lessen the course of the currents and eddies against the embankments, but to restrain the debris on the surface, thus using it as a reinforcement to the bank, preventing it from becoming a dangerous menace when the river is in flood.

One of these levees has been completed from the town of Yuma to the site of the dam, and its brushwork defenses have been finished for a distance of about seven miles. Another levee has been completed from Yuma to the Mexican boundary, a distance of 20 miles. This section has already been called upon to resist several floods in the Gila, and has withstood the impact of the waters without a break, although it contains no stonework whatever, and its composition including its dikes is merely earth and wood. In completing plans for the Yuma system, the engineers in charge had to consider another difficult proposition—how to free the water in the rivers from the detritus which is held in solution at all seasons of the year, especially during high water. If the canals were to be filled directly from the rivers by the usual headgates, such a deposit would be carried into them and their branches that frequent excavation would be necessary to keep the ditches from being filled. As the water distribution in this way would be impracticable, the plans decided upon included arrangements for intercepting the deposits carried in solution to such an extent that the water entering the canals will contain but a small percentage, even during the flood season. While the Laguna dam will divert the water of the Colorado into the main canals described, it will be really of more importance in forming what might be called a settling basin. Here the velocity of the current will be restrained, and a pool formed, permitting such precipitation. But the brushwood dikes described will also be an important adjunct in this respect, especially during high water. They are not intended to prevent the water from flowing through them to a certain extent, but to check the current. During this operation much of the detritus, it is expected, will be caught against the dikes, and thus they will serve to filter the streams.



Section of Completed Portion of Yuma Levee.

IRRIGATION OF THE YUMA VALLEY.

The Yuma project is expected to be entirely finished next year when water will be available for the hundred thousand acres mentioned. The soil to be treated has been analyzed, and found to be of an extremely fertile character when sufficiently moistened, while the climate is favorable for the raising of crops native not only to the temperate zone but the tropics. Yet this is a country of which the scientists have said, "It has no bottom," owing to the great depth of alluvial soil which covers the natural surface, carried down by the Colorado and its tributaries. Consequently, the work of the Reclamation Service in constructing irrigation works of such magnitude in this region is an engineering feat of no little importance.

Prof. Forbes's Theory of Jupiter's Eighth Satellite.

The great distance of Jupiter's eighth satellite from the planet, and its retrograde motion, which are matters of profound interest in the astronomical world, have led Prof. George Forbes, F.R.S., to advance an interesting and reasonable suggestion in regard to this celestial object.

"While speculation is premature," says Prof. Forbes, "it is impossible to resist the conjecture that there is a bare possibility that this new satellite is really the long-lost Lexell's comet which was discovered in 1770, with a periodic time of five and one-half years. In August, 1779, this comet approached Jupiter within 0.01 of the earth's mean distance from the sun and has not been again observed."

At that distance Jupiter's attraction exceeds that of the sun in proportion of at least 200 to 1, and the distance from one of the satellites may have been very small and in this way, Prof. Forbes thinks, it is not impossible that the comet may have been diverted into an elliptic orbit round Jupiter, and a retrograde motion round the planet would be as likely to ensue as a direct motion.

The learned English professor concludes his observations by saying: "Should further observations reveal a moderate eccentricity the impossibility between this satellite and Lexell's comet will be proved."

Disturbing attraction of the outer planets has ever been a hard question for the astronomer—involving the question of orbits in limitless space either parabolic or elliptical, on which so much depends in astronomical calculations. Laplace, the eminent French astronomer, worked for years on the problem, which has arisen in this recent discovery, in the orbit of the giant member of our solar system. Laplace found that when an irregular comet passed closely in front of a larger planet its velocity would be retarded to such an extent that it would fall into an elliptical orbit and become periodic. If the planet were Jupiter it would be said that the comet had been "captured" by Jupiter and belonged to Jupiter's family. Its aphelion point would then remain near Jupiter's orbit, as Jupiter's mass is greater than all the other planets combined and its influence over comets is proportional to its mass.

Bacteria and "Molecular Motion" Seen with the Naked Eye.

Very fine particles suspended in a liquid perform oscillatory movements which were first observed by the English botanist Brown and are known as Brown's molecular motion. The phenomenon, which, until recently, has been observed only with microscopes of high power, is very conspicuous in the milky sap of the *Euphorbia*, which holds in suspension very fine globules of resin and caoutchouc. As the diameter of the largest of these globules does not exceed 1/50,000 inch, while the diameter of the smallest object that can be perceived, in the ordinary manner, with the eye is about 1/2,000 inch, no hope of observing the phenomenon with the naked eye was entertained; but Prof. Molisch of Prague has discovered that the motion may be made visible by a method of illumination similar to that which is employed with the microscope. A drop of the sap is placed on a glass slide which is held in a vertical or slightly inclined position before the eye and observed by the transmitted light of a sunbeam which strikes the glass obliquely. When the proper position has been found by trial the molecular motion suddenly becomes visible as a rapid flickering and dancing of the globules, which are tinged with beautiful colors due to diffraction. The brilliancy and distinctness of the picture are increased by placing a black background a couple of inches behind the glass. The visibility of the phenomenon under these conditions is probably due to the enlargement, by diffraction, of the retinal images of the globules

Bacteria, which are in general much larger than the *Euphorbia* globules, have been seen with the naked eye by Prof. Molisch in the same manner.

The American Society for the Prevention of Cruelty to Animals will shortly begin experiments with a new method for killing animals. Henry Bergh, the treasurer and former president of the society, has invented an air gun of large size, working like a pneumatic hammer. The society some time ago offered a reward of $500 for an improved and humane method for slaughtering purposes. Mr. Bergh thinks his invention fulfills the requirements of the society for an improved device for slaughtering animals.

The $25,000 Transvaal Stope Drill Competition.

We have already briefly referred to the Transvaal stope drill competition, which has been organized by the Transvaal government and the Transvaal Chamber of Mines. The London Engineer publishes the following additional information:

The object of the competition is to obtain a small drill capable of economic use in narrow stopes on the Witwatersrand, which are at present worked for the most part by hand labor. It is stated in the rules that no entry will be accepted in respect of a machine which weighs more than 100 pounds. It is desirable that the machines should be as light as possible. The main part of the trials or competition will, it is thought, extend over a period of six months. In order to reduce the entries for the prolonged underground test to a number that can be conveniently handled, elimination trials will be held successively on the surface and underground. Only those machines which have passed the surface elimination trial will be allowed to enter the underground elimination trial. At the conclusion of the latter trial the committee will arrange the entries taking part in the chief test in the order of merit with regard to footage drilled and air consumed, and will then decide which may enter the competition. Two machines of each entrant will be run for 300 shifts each by day and night continuously, with the exception of Sundays and legal holidays. The length of shift will be of equal duration on each mine. The mines and working places in which the competition will be carried out will be selected by the committee, and, so far as practicable, each entry will be run for an equal period in each stope in each mine selected.

During the competition the machines will do ordinary mining work, in accordance with instructions given to the miners. Not more than two holes on any rig-up shall be counted, unless the committee expressly sanction it. The competing machines will not be required to cut pillars, box holes, etc. Numerous other regulations dealing chiefly with spare parts are given which we have not space to reproduce here. The last two rules state that the air pressure must not exceed 75 pounds per square inch, or be less than 60 pounds per square inch. The air consumption of each machine will be tested on the surface at least once a month during the competition.

Handsome rewards are offered to the winning machines. The first prize is $20,000 and will be awarded to that group of machines for which the total cost, when divided by the total footage drilled by them during the competition, is least. The second prize of $5,000 will be awarded to that entry which is considered by the committee to be the second best. The right is reserved, however, in case of two or more entries showing approximately equal results, to ignore small differences in points, and award the prize to that entry which is considered most suitable for the conditions prevailing upon the Rand, having regard to weight, general design, ability to drill deep holes, freedom from stoppages and breakdowns, facility of handling, and suitability for narrow stoping. Those who are interested in this competition should apply to the secretary of the Transvaal Chamber of Mines, 202 Salisbury House, Finsbury-circus, London, E. C., England, for a copy of the regulations.

Providing for Future Railroad Ties.

The Santa Fé system is perfecting plans for a forest of eucalyptus trees in San Diego County, California, from which to obtain a steady supply of crossties. A ranch of 8,000 acres has been purchased for this purpose, and as a start 600 acres will be planted. It is estimated that in eighteen years the company will be able to harvest from six to eight ties to a tree, and keep up the harvest thereafter continually. At present the Santa Fé system uses about 3,000,000 ties annually. In eighteen years the company thinks it will be able to obtain from its forest 7,000,000 annually.

The growing scarcity of timber suitable for ties, with a resultant increase in their cost, has led eleven roads, including the Santa Fé, to start forests. Ten roads in the East have already planted in their respective forest sites thousands of catalpa, black locust, red oak, pin oak, and chestnut. The Santa Fé has selected the eucalyptus because of its rapid growth and adaptability to the climate of California, New Mexico, and Texas.

Eucalyptus ties in Hawaii are said to last fifteen years. East of Albuquerque the Santa Fé is using Georgia pine. At present both the Santa Fé and Southern Pacific are using many thousands of redwood ties on the coast. They are also getting oaken ties from Japan.

Correspondence.

Improvements in Whaling Methods.

To the Editor of the SCIENTIFIC AMERICAN:

Whaling as it is practiced to-day is not very different from whaling of thirty years ago. The appliances for catching the whales, the manner of extracting the oil from the blubber, and the methods of converting the meat and bones into marketable products are about the same.

The most noticeable development in whaling at present is the employment of large old steamers as stationary floating factories in place of fixed permanent structures ashore. However, these floating factories as they are operated at present must of necessity form only a transition stage in the development of this manner of whaling. They are all fitted with appliances for working the blubber only; the carcases are flensed lying alongside the vessel in the water, and after most of the blubber is removed the huge masses of meat and bones are left to drive before the wind and tide. Last season the catch from South Georgia, South Shetland, and the Falkland Islands amounted to about 40,000 barrels of oil divided among seven companies. The average yield of oil given up by one of the largest companies was about twenty-five barrels per whale. This means that about 1,600 carcases were let adrift in one season! Mankind of to-day does not take kindly to wholesale waste of such proportions, and it must only be because the British government is uninformed about the matter that this state of things is allowed to pass on. No license ought to be issued to any company except under obligations that the carcases are worked up. Quite recently a Norwegian company with a capital of about $250,000 was formed to carry on sealing and whaling around Kerguelen Island and it is the intention of the company to work up everything. The managers figure on a net profit of forty per cent on the capital invested, as based on the experience gained from an expedition to the same waters last year. And Kerguelen Island is just as far from the markets as is South Georgia.

In the March number for this year of the Norwegian Fishing Gazette (Novak Fiskritidende, Bergen) the Gazette's regular correspondent upon whaling matters writes on the subject of floating factories:

"The unfortunate condition of the whole affair is that the carcases are so poorly utilized and that large values are wasted. The whole business must therefore be characterized only as a depredation which must mark only a transitory stage. When only half the value of an animal is utilized there must be something deficient and this must be remedied if the business shall be able to satisfy our economical sense."

The correspondent advocates full equipment of apparatus for utilizing the whole of the carcases.

All that is needed, however, is, as a strict condition for obtaining licenses, that the carcases must be worked up. The rest is certain to follow of itself.

Christiania, Norway, May 26, 1908. J. A. MÖRCH.

Suggestions for Utilizing the Silt of the Mississippi River.

To the Editor of the SCIENTIFIC AMERICAN:

While in the South some years ago, I had many opportunities for observing the action of the lower Mississippi River, together with its tributaries, bayous, outlets, banks, overflows, deposits, excavations, levees, blankets, etc. This queen of the rivers of the world is a grand subject of study; there are many grand features which stamp indelible impressions upon a man who is capable of being impressed by original ideas. One of these ideas I wish to express in this article, the subject being "The Mississippi Silt; Its Extraordinary Value; How to Secure This Grand Source of Wealth, Now All Going to Waste."

By relieving the river bed of this silt, we will find many other advantages will accrue; the channel will be cleared, deepened, and broadened at the most necessary points first, later all along. This will improve navigation, relieve the strain on the levees, check the overflow and consequent inundations, adding greatly to the certainty of crops and value of land in the whole length and breadth of the Mississippi Valley, giving drainage to the banks between the levees and shores, which can be planted with pecan and other nut-bearing trees in the driest places, with bamboo and osier willow in the wetter places, by which means these strips, being planted the whole length, will become of as great value as the land outside the levees.

Considering the value of the silt, it is beyond estimation. Ten miles of this great river properly dredged will yield more fertilizing material and much more complete in requisite chemical, analytical, requisite component parts for available plant food than all the guano that has been shipped from Peru to all parts of the world during the last sixty years. Then this dredging can be repeated annually.

What is required is a pump dredge on a large flat-boat with all the machinery and equipments necessary to raise the silt, riddle it, dry it by passing over rollers on wire cloth or canvas carriers, until thoroughly dried, then resift and send through a vacuum tube by an air current as a starter and have the air exhausted in the tube at requisite intervals; in this way sending the silt out rapidly to any distance required from one mile to three thousand miles with a force and rapidity simulating the air currents which sometimes pass through canyons in the mountain regions at a fearful rate of speed for days at a time, through natural forces generated by different temperatures. At the end of this passage a flexible wire frame with canvas lining can be used to distribute the silt on the soil wherever desired. Just a little of this, say 1/16 of an inch, will add surprisingly to the fertility of any upland soil, causing it to produce an augmented yield for seven to ten years after this small deposit has been made; but the more the better. The quantity can be regulated according to the soil's requirements.

There is no more perfect fertilizer than this silt, being a combination of volcanic ashes with decayed vegetation strongly impregnated with animal, lime, and mineral substances in well adjusted proportions for perfect plant building. A man told the writer a few days ago that he saw an unusual rise of water which stayed at a depth of two to four feet for three or four days and always after that freshet all the crops grew much better for several years.

While in the State of Louisiana a man told me that the noted overflow of 1835, when the levees broke above New Orleans, caused a deposit of from three to seven feet of silt on the plantations, and that since then they had a soil equal to a Cuban soil in fertility. Every observer of the fertility of river silt deposits will agree with the statement that it is in most cases the best fertilizing material that they have yet found. There are, of course, a few exceptions to this rule, where, for instance, inferior clay, sand, gravel, or combinations of such materials are deposited, but these can be avoided in selecting river deposits to improve worn-out or naturally poor soils. Silt would pay much higher dividends than guano, if sent out to the fields by rail; but the pneumatic vacuum current will yet be proven to be very much more economical and convenient as well as more direct, depositing the material already spread in any required proportions ready to be worked into the soil. All will be done practically in a single operation from river bed to the field.

The numerous crooks and turns in the course of the Mississippi give unusual advantages for establishing retaining breaks for capturing the annual flow of silt estimated by carefully calculating engineers to amount to a cubic mile in bulk. From my own opportunity for observation I could readily believe the statement that it is two to three times greater in amount of bulk after all large bodies and undecomposed, such as driftwood, bark, grass, and weeds.

President Roosevelt's proposition to have the whole American people enter into a united effort to preserve the natural resources of the country is an idea worthy of closest possible attention and careful training of all the people individually as well as collectively to adhere to. Preserving the forests holds the water for irrigation, power, and navigation and contributes to steady the flow. In this way preserving one of nature's resources aids to retain many others; but this silt will in the course of a few years be proven to be the most valuable asset of all known natural resources. Such old countries as Spain, France, China and all countries which have any poor soils or impoverished through an exhaustive system of cultivation will have their fertility restored by the silt of their flowing rivers.

Why have the rivers of so many countries been permitted to go on washing away their fertility for ages with almost no effort put forth to check this drain upon the vitality of the agricultural constitution of the fields? When shall we begin to check this waste? J. A. STOCKFORD.

Spokane, Wash., June 25, 1908.

A Training School for the Consular Service.

Efforts are being made to render a large public service to American commerce by means of a new training school for the Consular Service under the auspices of the new College of the Political Sciences of the George Washington University at Washington, D. C. All importers and exporters would be benefited by more highly-trained consular officers. Next to the conservation of our natural resources, the most important thing to be done, especially along educational lines, is to develop a new type of highly-trained public servant, not only in national, State, and municipal politics, but particularly as consuls and diplomats. The new courses outlined call for training in diplomacy as well. Dr. Richard D. Harlan can be addressed care of the University for further information, and he will also receive contributions to aid in launching the new enterprise.

Termination of the Glidden Tour.

Upon the termination of the Glidden tour on July 23, after three more days of running from Boston to the Rangeley Lakes in Maine and thence to Bethlehem, N. H., and Saratoga, 3 teams, 5 runabouts, and 14 other touring cars finished the 1,700-mile reliability test with perfect scores. Thus 28 machines out of 45 that started finished with perfect scores, which is a very creditable showing indeed.

The teams that tied for the trophy were the Buffalo team of 3 Pierce-Arrows, the Columbus team of 3 Peerless cars, and the Chicago team of 2 Haynes and 1 Oldsmobile machines.

The 14 other perfect-score touring cars were 2 Franklins, 2 Studebakers, 2 Stevens-Duryeas and 1 each of the following: Gaeth, Garford, Marmon, Oakland, Premier, Reo, Ranier, and Thomas. One of the three Marmon touring cars had the misfortune to crack a cylinder in the last day's run of 184 miles, but both it and its mate, which broke down a couple of days before, were able to finish the tour. Another car to make a creditable showing in this respect, although it broke its rear axle in the White Mountains, was the little Overland runabout, No. 110. The five runabouts that finished with perfect scores were 2 Pierce-Arrows, 2 Stoddard-Daytons, and a Premier. These machines will continue on to Buffalo and go over the course a second time if necessary till the winner is determined. Last year, it will be remembered, a White steamer and a Stoddard-Dayton tied in this class, and the former only won the Homer Trophy after running a considerable distance in addition to the regular tour.

Henry Farman to Fly at Brighton Beach.

Henry Farman, the celebrated aviator who won the Deutsch-Archdeacon $10,000 prize for a flight of a kilometer in a closed circuit on January 13 last, arrived at New York on July 26. His aeroplane reached America several days later on another steamer.

Arrangements have been made for M. Farman to give a series of exhibition flights at the Brighton Beach race track beginning August 1. The first of these will probably be short, straight-line flights across the center field, as the aviator, daring as he is, will hardly attempt to fly above the mile track, which is lined with fences. Would-be spectators must remember, too, that in a slight breeze Farman's machine is impractical and that consequently they will have to take their chances upon witnessing a flight on the date set.

Farman, we understand, has again challenged the Wrights to fly against him in a competition, and we presume that in about a month, after the latter gentlemen have finished their contracts here and in France, these foremost aviators will successfully defend the SCIENTIFIC AMERICAN Trophy in an international competition which the Aero Club of America will doubtless hold.

Wilbur Wright is only just recovering from a severe scalding he received a month ago when the water pipe of a motor he was testing burst. His machine is practically ready for the two 50-kilometer (30-mile) trial flights he has to make above the race track at Le Mans, France, with a passenger, and it is expected that within ten days the first of these flights will be made. Orville Wright has the two-man aeroplane he is working on for the War Department about completed, and he expects to make tests of it at Fort Myer, near Washington, within a month. Capt. Baldwin's government dirigible is already at Fort Myer and it will be tested within two weeks.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1700, is written by the Paris correspondent of the SCIENTIFIC AMERICAN. The subject is the stirring Grand Prix automobile race, which recently attracted worldwide attention. Some simple calculations for choking coils are published. Austin B. Fletcher gives a brief description and discussion of the several processes and essential features entering into the construction of macadam roads in rural sections. Edward S. Sperry tells how phosphor bronze is made. Prof. James Rignall Wheeler gives a brief account of Mycenæan civilization.

For some time past, the daily press has been interested in the production of diamonds artificially. Long articles have been written upon the subject, and various persons, scientific and otherwise, have been interviewed, largely because of the prosecution of M. Lemoine by Sir Julius Wernher, on account of his failure to produce diamonds by chemical means, after claiming his ability to do so. For that reason, an article is published in the current SUPPLEMENT in which the possibility of producing diamonds artificially is scientifically discussed. Two new methods for the preservation of foodstuffs by means of nitrogen and by pressure are described by Dr. P. Martens. Samuel Diescher writes on coal washing, and gives a description of the apparatus employed. Wood preservation is discussed by W. F. Sherfesee.

ERECTING THE CONSTRUCTION FOOTWAYS OF THE MANHATTAN BRIDGE.

The work of erecting the construction footways from which the cables of the new Manhattan Bridge will be woven, or to speak more strictly, will be "strung," has progressed so rapidly that, by the time this issue is in the hands of our readers, they will be practically completed. As they are already aware, the floor of this bridge will be hung from four large cables, each 21½ inches in diameter, measured on the wires without the wrapping or sheathing. Each cable will contain 9,472 galvanized wires 0.19 inch in diameter. The total length of single wire in all of the four cables together will be 23,100 miles, which would nearly suffice to girdle the entire earth. The wire will have an ultimate strength of 215,000 pounds to the square inch; and the main cables will be subjected to a working load of 60,000 pounds, and a congested load of 73,000 pounds to the square inch. The side spans of the bridge will be 725 feet, and the central span 1,470 feet in length. The total weight of steel in place, when the structure is completed, will be 42,000 tons. The suspended roadway will consist of four trusses, each 24 feet in depth center to center of chords. Each pair of trusses will be spaced 28 feet apart, and there will be a spacing of 40 feet between the inside trusses of each pair. Provision will be made for four railroad tracks, two of them on the upper, and two on the lower deck of the trusses; and two footways each 10 feet wide will be carried on the outside of the bridge upon cantilever extensions on the floor beams. The central roadway for vehicles, 35 feet in width, will occupy the center of the bridge at the level of the lower deck of the trusses.

The weight of the four great cables in their completed condition will be 6,300 tons. Each cable will be built up of thirty-seven strands, each 3½ inches in diameter, each strand consisting of 256 wires. At the anchorages the strands will pass around sheaves, held by the massive anchorage I-beams which are already in place, firmly imbedded in the masonry of the anchorage. In laying the cables, the wire will be drawn to and fro across the bridge until the necessary 256 wires have been placed, to form a strand. At each anchorage, and on a series of wooden trestles, two on each end span and five on the main span, erected on the working platform, are a series of sheaves or pulleys, on which the wire in making up a strand is laid. There are four of these sheaves at each anchorage and on each trestle, so that four strands may be in the process of assembling at the same time, two being woven a few feet to the right of the main cable, and two a few feet to the left thereof. As soon as a strand is completed, it will be lifted out of its set of sheaves and transferred to the main saddles, of which there is one for each cable at the top of the towers, and one at each abutment.

The working platforms are carried upon four temporary cables, each consisting of four 1¾-inch diameter steel ropes. These cables are spaced 22 feet center to center, and at every 18 feet of their length they are spanned by a pair of 6 x 12 floor beams, which are laid upon and bolted to them by stout U-bolts passing round the cables and drawn up snugly against the floor beams by means of washers and nuts. The floor beams, which are 28 feet in length, extend beyond the platform cables for a distance of 8 feet, and upon this projecting portion, which lies immediately below the cables, is laid a series of longitudinal 4 x 8-inch stringers, to which is nailed down the plank flooring, 8 feet in width. At a height of about 3 feet from the platform thus provided, one above each edge of it, are strung two ¾-inch wire ropes with posts extending from the ropes down to the platform beneath at regular intervals. To provide against the undulation and distortion of the platforms by heavy winds, four storm cables, each 1¾ inches in diameter, are strung beneath the platforms and cradled both in the vertical and the horizontal plane. At intervals of 55 feet, vertical tying cables extend from the platforms to the storm cables, and at the towers a series of diagonal ties are also run out from the towers and attached to the platform at the top of the vertical ties. This system of stiffening will hold the platforms perfectly secure against any serious oscillations during the work of cable construction.

When the thirty-seven strands of a cable have been laid, and placed in the saddles, the whole mass will be clamped into true circular form and the weather protection, probably in the form of a sheathing of steel plates, will be laid on with joints overlapping so as to shed all water and protect the wires from the weather. At intervals of 18 feet, heavy clamps will be placed around the cables, and from these will be hung the 1¾-inch suspenders to which the massive floor of the bridge with its trusses and platforms will be suspended. The suspenders will be made largely from the wire ropes composing the erecting platforms, and as there is about 48,000 feet of these, they will go far to supply the necessary amount. It is estimated that the work of stringing the cables will be completed in from six to eight months' time.

Soundings in Niagara Gorge and Under the Falls.

BY DR. J. W. SPENCER.

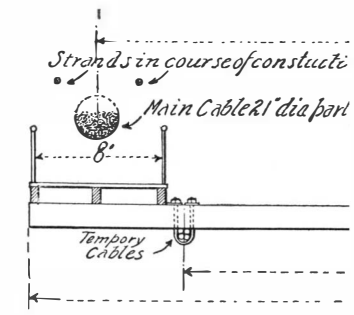
In order to determine what work the Falls of Niagara had accomplished at each point in their recession the writer, by a special application of sounding methods, recently undertook to bring to light the physical features of the gorge. Apart from soundings in the vicinity of the crossing of the "Maid of the Mist," and at the cantilever bridge, none had previously been undertaken, so that even the depth of the river in front of the American Falls, and nearer the Canadian Falls, as well as in the gorge generally, was not known. The Whirlpool was a mystery, and it was thought impossible to sound under the falls themselves.

Owing to the velocity of the currents and to the ordinarily inaccessible position for making soundings by the usual methods, the determinations of the depths of the river by the length of the sounding wire were out of the question, so that other methods had to be employed.

From the falls to the head of the Whirlpool Rapids the distance is about two miles, where the slope of the river surface probably does not exceed one foot. Throughout this section the soundings were made from the steamer "Maid of the Mist," but even here the currents were strong, so that the fine cable used, having the weight attached to the end, would be carried down farther than the true depth of the river. In order to overcome the error, resort was made to determining the weight of the water by hydrostatic tubes. The Thompson sounding tube could not be used, as it requires salt water; but the Tanner-Blish tubes are suitable in either fresh or salt water. The construction of these is simple, consisting of a glass tube two feet long, with a very small bore, which is not smooth but ground with concentric rings situated close together. The upper end of the tube is covered with a rubber cap, and the whole inserted in a brass tube so that the glass tube rests on a spiral spring for the purpose of cushioning the jar on the glass tube. This pair of tubes is then inserted in a sounding lead. Two leads were used, the lighter twelve and one-half pounds in weight, and the heavier thirty pounds. In any case the weight of the lead must be very much greater than that of the cable paid out. Such being the case the weight sinks rapidly to the bottom, although in the strong current it would be somewhat carried down the stream before it reached the bottom. The position was determined by two transit men, with their instruments, looking down from the cliffs above.

This ground glass tube, as described, appears transparent when dry, but when the water is forced up from the lower end, the concentric rings prevent the inside of the glass from being wet beyond the point to which the water rises, so that this is very sharply marked, showing the amount of the compression which the air in the tube has undergone. This is subsequently measured by a scale, which is graduated to a depth of 600 feet, but the readings become too fine to be of much value beyond 400 feet in depth. This, however, was much greater than was needed in the Niagara River.

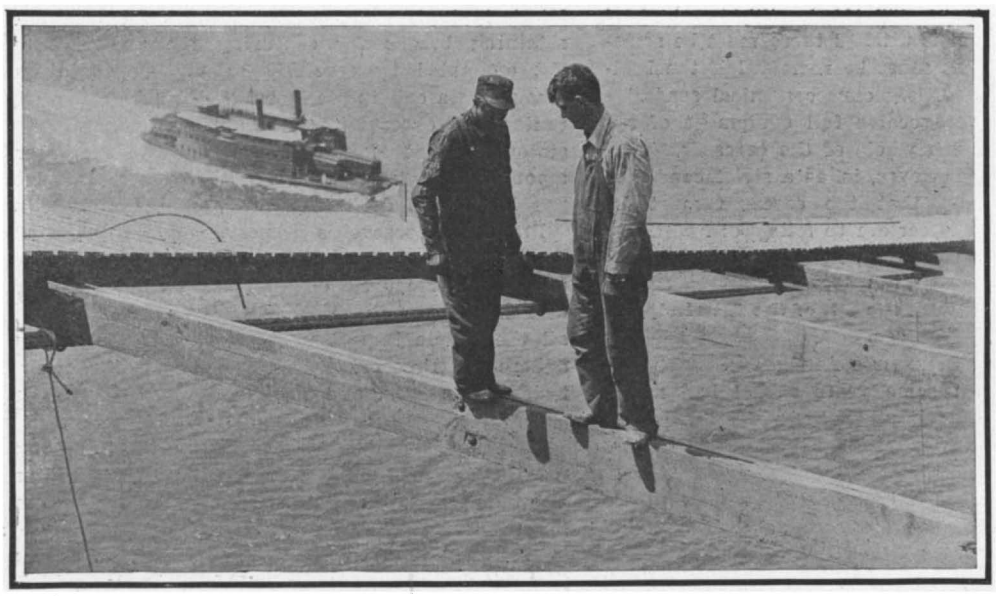
In the Whirlpool and other rapids the soundings would probably be impossible, as a sounding lead would doubtless be caught between bowlders so that it could not be recovered. But these rapids represent a refilling of the channel from the rocks falling from the sides of the gorge, so that even the river bed here would not represent the true depth to which the gorge had been excavated.



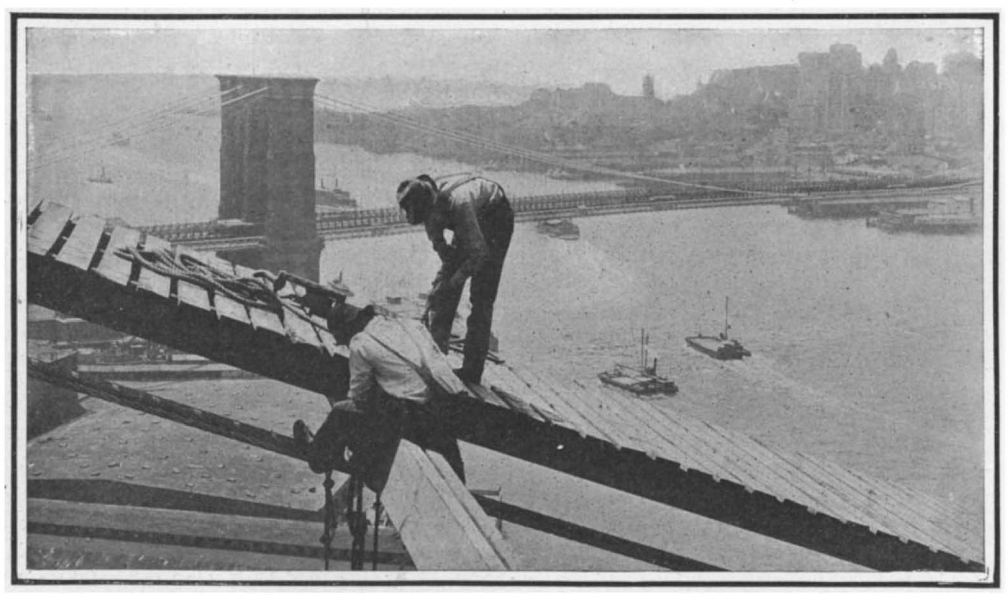
Cross-Section of Two Foot Strands and Plac

Below the outlet of the Whirlpool the soundings were eventually taken in a small boat, where the men had learned to navigate the dangerous currents. Besides getting a large number of good soundings here, the sounding lead was dragged over the center of the river, so that the maximum depth obtained, as the instrument only records the greatest depth that it has reached.

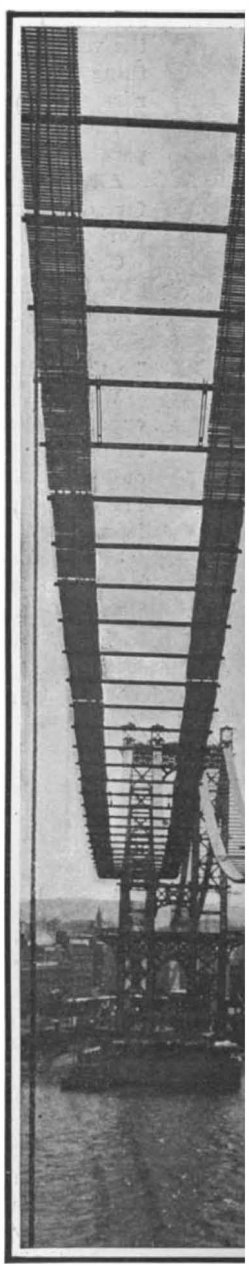
Top of Tower, Showing Temporary Timber Structure.



The Two Men Are Standing on a Pair of the 6 x 12 Inch Floorbeams Which Support the Footways. They Are 155 Feet Above the River.

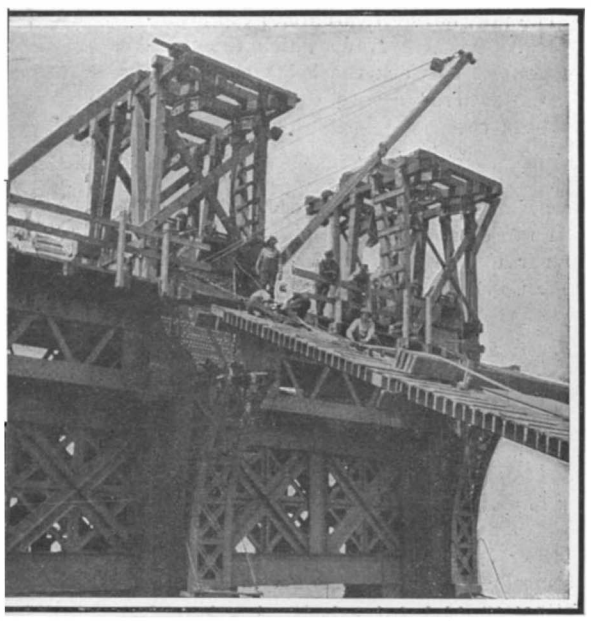


Tightening Up One of the U-Bolts That Tie the Floorbeams to the Cables.



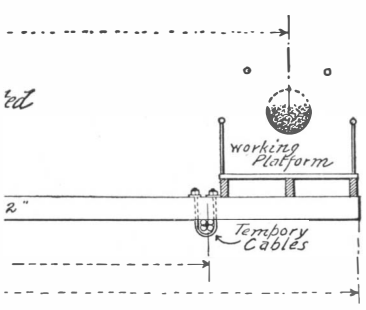
The Footway

BUILDING THE FOOTWAYS FOR THE STI



Top of Manhattan Tower, Showing Footway and Temporary Timber Erection Towers.

The soundings in the Whirlpool form a different roblem. The breadth is about 1,150 feet. Here the ater enters on the right side of the channel, sweeps ross its outlet, circles around and passes under- eath the upper current through the opening in the side of the gorge. On account of this circulating current, there are always great numbers of logs seen whirling around in the pool; the same individual piece may be seen circulating in the Whirlpool for ven weeks, and it is rarely that one sees a piece of ood passing out, although the timbers are carried ut by undercurrents. As these timbers are swirling round, they are often caught in the vortices, or funels, and are drawn underneath the surface, when they are seen to pitch down, with the other end standing in the air. Most of these timbers come to the surface again, with an occasional one passing out of the whirlpool by the undercurrent. Here then navigation across the center is, of course, impossible, but a boat can go in safety around the margins. In studying the physics of the river it was absolutely necessary to determine the depth of the Whirlpool, and in order to determine it some method had to be devised. Accordingly, a cable was carried from one side of the Whirlpool around to the other in a boat, and after much trouble it was made to clear the mass of swirling logs and carried up the hillsides to a height of about 80 feet to a movable drum at each end. A clamp holding a pulley wheel was now attached to the cable, crossing the gorge, and through this pulley wheel a second cable, with a sounding lead, was operated from the shore. By the means of the movable drum the position of the sounding lead could be located where desired, and the same hydrostatic tubes were used for registering the depth.



owing Method of Assembling ı in the Main Cable.

The soundings under the Falls involved an entirely different proposition, as no cables could be carried across the river. For this purpose I designed a buoy, which was subsequently sent over the river several times and registered the depth of the river beneath the Falls themselves. This buoy was composed of a piece of very light wood three and one-half feet long and eight inches in diameter. The lower end tapered to a point, which was very heavily leaded and capped with a lead shoe. Inside of the buoy were placed two Tanner-Blish sounding tubes in their brass cases, and these packed in curly hair, so as to reduce the effect of the blow in their fall. As the buoy floated only about six inches above water, and was shaped so that the force of the falling water would drive it down as far as possible, it was made visible by having a small iron rod protruding above the upper end and bearing a red flag. The course of the buoy was observed by men on the shore. It was driven down by the falling water until it struck the fallen blocks of rock, as shown by the markings on the lead shoe. It subsequently arose to the surface and was picked up farther down the river. The tube was repeatedly sent over the Falls and recovered. The results obtained were surprising, as the depth of the buoy struck the fallen rock at only 72 feet. In the center of the river, farther down, the depth was from 84 to 100 feet, but a lateral channel reached 192 feet. The effective excavating power is thus found to be about 100 feet below the surface of the river. The greater depth resulted from the previous lower river surface. The line of deepest soundings repeatedly showed 186 feet to near the cantilever bridge, about two miles below the Falls. Under the bridge the maximum depth is 85 feet (found by engineers for the railway company). Here also borings were made beneath one of the piers, showing a refilled channel to a depth of 185 feet. The descent of the Whirlpool Rapids is 51.5 feet. A section across it shows a maximum depth of 102 feet, but in the river course itself a depth of 126 feet was obtained, but it is possible that one from 8 to 14 feet more may occur just beyond. Thus from near the Falls to the Whirlpool the floor of the cañon is found to reach 87 to 90 feet below the level of Lake Ontario.

Just below the Whirlpool great changes occur in the gorge, and at a quarter of a mile farther the maximum depth was found to be 99 feet, or 59 feet below the level of Lake Ontario. As the Whirlpool Rapids are produced by the fallen rocks refilling the original channel, so also Foster Rapids are due to the same cause. Other measurements were made. Those a short distance within the gorge were found to reach 150 feet, and others some distance beyond its termination showed a narrow inner channel to a depth of 183 feet, or 181 feet below the level of Lake Ontario. These discoveries were hitherto absolutely unsuspected.

These results show that the narrow channel was formed when the level of Lake Ontario was about 180 feet lower than now, at the time when the Niagara was draining only the Erie basin and not the four upper Great Lakes. They show that the Falls were once very much higher than now, and that the last cataract of the three which composed them was alone over 300 feet high, and the whole aggregated over 500 feet.

The soundings also complete the proof that the Falls were located just above Foster Flats, or about three miles within the end of the gorge, when the volume of the Niagara was vastly augmented, owing to the addition of the waters from the three highest lakes, which now took place. Again the soundings at the Falls bring to light the fact that the modern cataract is not so high as it was a few hundred years ago, before the completion of the Whirlpool Rapids.

Hot-air-driven Torpedoes.

Experiments made by the firm of Sir William G. Armstrong, Whitworth & Co., in December, 1906, at Weymouth, England, with hot-air-driven torpedoes, were lately resumed by Messrs. Whitehead & Co., at Fiume, Hungary, with very satisfactory results.

The air was heated on its way from the tank to the engine in a combustion chamber of the smallest dimensions possible. The air-regulator is placed between the combustion chamber and the tank, so that an increase in temperature and pressure of the air in the tank is made entirely impossible. The apparatus works therefore at a low pressure, minimizing the danger.

The apparatus as now constructed combines absolute safety with light weight and small dimensions. The air-tank is of the same construction as in ordinary torpedoes, and is not affected by heat or overpressure.

The experiments were made with an ordinary 45-centimeter (18 inches) torpedo, fitted up with the apparatus, and gave the following results:

At 1,000 meters (1,100 yards).....	35 knots
At 3,000 meters (3,300 yards).....	30 knots

The same torpedo, shot "cold," gave the following results:

At 1,000 meters (1,100 yards)....	33.80 knots
At 1,500 meters (1,750 yards)....	29.08 knots
At 2,000 meters (2,200 yards)....	25.63 knots

These figures show, therefore, an increase of 100 per cent, or say, with the same quantity of air, the torpedo may be shot at double the distance with increased velocity.

Besides the increase in energy, the heating of the air presents the great advantage of entirely obviating the considerable drawbacks of too great a cooling off, especially in the northern seas and during severe winters.

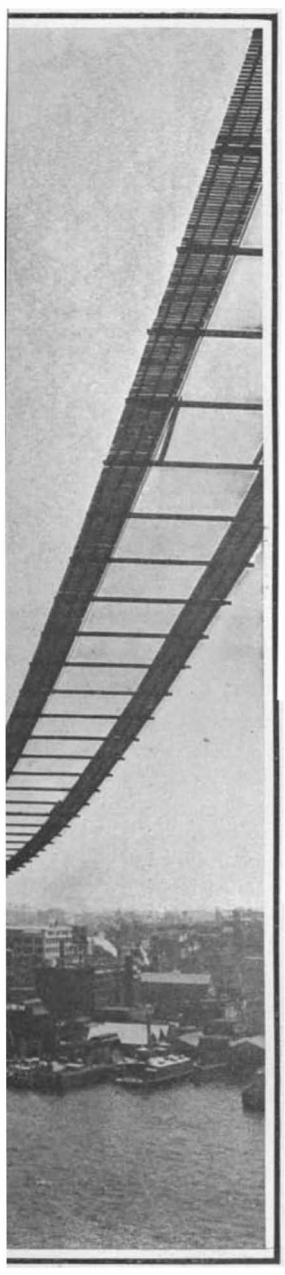
Very interesting results were obtained with another series of experiments, in which ordinary coal oil was used as fuel instead of benzine. The results of these experiments, although made only up to 2,000 meters (2,200 yards), gave the same results as those with benzine. As ordinary coal oil is entirely safe to handle, these experiments are of great value.

A special advantage of the apparatus is that the stopping of the torpedo automatically stops the heating, thus avoiding a sudden increase in temperature or pressure, unavoidable with non-automatic contrivances that may easily bring about an explosion, or a melting of the metal parts.

The apparatus is so arranged as to allow also of a "cold" shooting of the torpedo.—Mitthlg. aus dem Geb. des Seewesens.

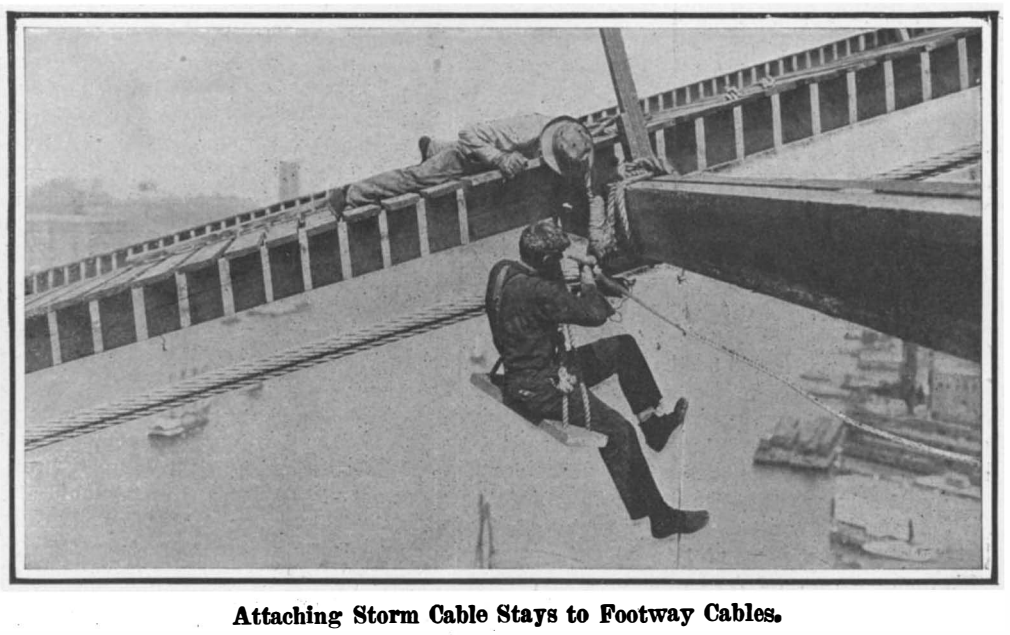
A $50,000.000 Suit Settled.

Judgment for the defendant by agreement of the parties was entered on June 19 in the $50,000,000 suit of Cadwallader M. Raymond of Somerville, Mass., against Henry H. Rogers in the Supreme Court. Raymond was assignee of a claim that the late Benjamin F. Greenough of New York had against Rogers and the late Charles Pratt under a contract made in 1878 for a secret process for making crude petroleum non-explosive. Rogers alleged that the process was never a success and was not used.



en from Below.

View from Top of Brooklyn Tower. Note the Removal of the Houses on the Line of the Approach.



Attaching Storm Cable Stays to Footway Cables.

NG OF THE MANHATTAN BRIDGE CABLES.

THE WORK OF A NEBRASKA CYCLONE.

On June 4 last the inhabitants of Buffalo County, Nebraska, and particularly of the town of Kearney, were besieged by no less than seven tornadoes. We are indebted to Edward C. Bricker for the accompanying photographs of the curious effects produced by one of these, and for the following brief information.

That a number of houses should have been wholly and in part destroyed is naturally to be expected of any cyclone that is at all violent. But that it should pick up a caster from a table, twist off the handle and drive the spindle through the branch of a walnut tree is surely no common occurrence. Mr. Bricker assures us that before the storm the caster found a place on the table of Mr. G. F. Franks, that it was intact with the bottles in their intended positions; yet after the tornado the base was found in a walnut tree limb, exactly as it is shown in the accompanying photograph. The wind had unscrewed the top and taken off the turntable. One of the bottles was found with twigs densely packed into its neck, without a leaf stripped. The bottle, however, was broken.

A Farm for Cultivating Pearls.

BY R. R. WINSLOW.

In the Gulf of Lower California there is in operation the largest pearl farm in the world, where the cultivation of pearls has been taken up as a practical industry. To harvest the annual crop of pearls raised on this farm requires the labor of one thousand people, including the modern pearl divers, whose methods have been completely revolutionized by the up-to-date appliances employed in this new industry.

Pearl farming, as originated by the Mexican company who own the big Lower California farm, is the result of the discovery of a very simple fact concerning pearl-bearing mollusks. After twenty-five years of study and experiment it was discovered that the shell loses its gem after it is two years old, and, unless opened at the proper time, there will be no pearl within. Following this discovery the system whereby the shells are cultivated until the proper time and then opened, was devised.

From the time of planting the eggs to the harvesting of the crop, two years must elapse, as that length of time is required for the growth of an ordinary shell. The eggs, which are gathered with the shells during the season when the eggs are being deposited, are placed in protective cages in the bottom of which are little artificial channels, made to imitate the bottom of the sea. The utmost care is taken to protect the young mollusks from their natural enemies. When they have arrived at the proper age, they are transferred to larger cages, also designed to protect them. During the transferring the stock is carefully inspected and all the "dead" or non-bearing shells are thrown out. The second cages are placed in deeper water and in them the shells are left to develop for two years, when the harvest of pearls is ready to be gathered. The divers descend into the cages with little risk, for, like the mollusks they seek, they are protected by the stout walls of the cage.

The crop produced at this remarkable pearl farm consists of three distinct kinds of gems, some ranging as high in value as $300 per carat. The black pearl stands highest in point of value. The white pearls are next, running up as high as $250 per carat, the price varying with the size and the state of perfection of the gem. The yellow pearl, although its brilliancy makes it a prime favorite among the feminine admirers, ranks third in point of value. The larger portion of the harvest goes to Paris, London, and Berlin, and the mother-of-pearl, which is exported in large quantities, going principally to Hamburg and Bremen.

The pearling methods in vogue across the equator are vastly different and serve as a horrible example of wastefulness. The usual method under the old system in addition to being most uncertain is unnecessarily destructive. In the search for pearls great quantities of shells are pried open, an operation that is certain death to the mollusk within. The extent of the waste by the old method is shown by the statement that at the Australian pearl fisheries one gem to the bushel of shells is considered a good catch. Many pearl fishermen crush the shells in their eagerness, thus destroying the value of even the shell; while others use the Oriental method of opening the shells, namely, piling them in the sun to dry and decay. On the model Lower California farm it has been demonstrated that it is possible to open gently the valves of the shell with a pair of tweezers to disclose the presence or absence of the pearl and to return the mollusk to the water alive and uninjured.

There is, however, one point of interest in the Australian pearling industry and that is the effective organization of the pearl divers. Most of these divers are Japanese. They have well-organized clubs and benefit societies, and every Japanese, whether belonging to the crew, tender or diving staff, is compelled by his countrymen to join. So strong is this organization, and so completely are the disunited pearlers at their mercy, that practically all demands are granted. This union has also been successful in violating the law which stipulates that no Asiatic shall hold a fishing license. The divers soon earn enough to purchase a boat for themselves, raw coolies having earned from one to two thousand dollars a year in addition to their living expense. The law, however, prohibits the granting of a license to Asiatics, to evade which the practice is to employ others to work the boats ostensibly as owners. These "owners" secure the license and transact the business connected with the work on a commission, the Japanese diver taking the bulk of the profits.

Wasteful methods and the successful competition of the modern pearl farm are being felt across the line, for from $2,000 per ton in 1901 shell has gradually decreased in value until at the last sales held in London it had fallen to $600 per ton. The successful cultivation of pearls by the new system, however, is said to be returning attractive profits on the money invested.

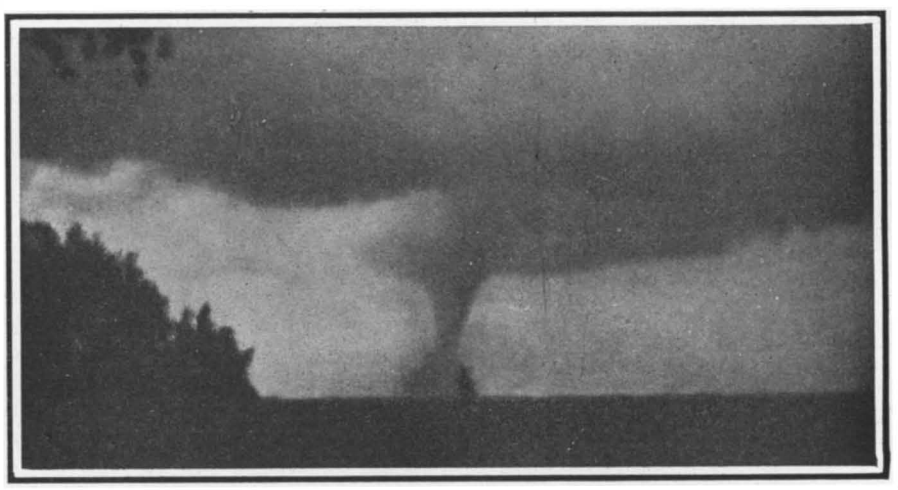
Mammalian Blood in Blood-Sucking Insects.

Many infectious diseases, including malaria, yellow fever, Texas fever, and the African sleeping sickness, are caused by protozoa carried from one human being or animal to another by such blood-sucking insects as ticks, Anopheles mosquitoes, and tsetse flies.

As the extermination of the crocodiles, the rhinoceros, and other large wild animals has been proposed as a means to the extermination of the insect carriers of disease, Uhlenhuth, Weidanz, and Angeloff have been conducting a series of experiments in order to determine from which animal species the insects draw blood. The well-known biological method by which an exceedingly minute quantity of blood can be detected and its species determined was employed. It was found that the red corpuscles of blood sucked by leeches remained intact in their bodies for eight weeks. In bedbugs the presence of human blood could be detected two weeks after it had been drawn. Similar results were obtained with human and animal blood in lice, fleas, and ticks. A number of mosquitoes of the species Anopheles, which has been supposed to feed chiefly on human blood, yielded only blood derived from cattle and swine. Uhlenhuth is planning a new series of experiments for the purpose of determining whether the rat flea, which has been accused of disseminating plague, does or does not suck human blood.

Lead, according to Cassier's Magazine, is said to act like steel at ordinary temperatures when reduced to a very low temperature in liquid air. It will serve as a helical spring, for example. This behavior of soft, non-elastic metals is very interesting. It shows how very important temperature is. Just as iron is soft and inelastic at a high red color, so lead is dull and soft at ordinary temperatures, for it is well on its way to be melted.

All That Was Left of a House After a Nebraska Tornado.



One of a Day's Seven Tornadoes.

A House Wrecked by a Tornado near Kearney, Neb. The Tornado Performed Many Curious Tricks, Among Them That Illustrated to the Right of This Picture.

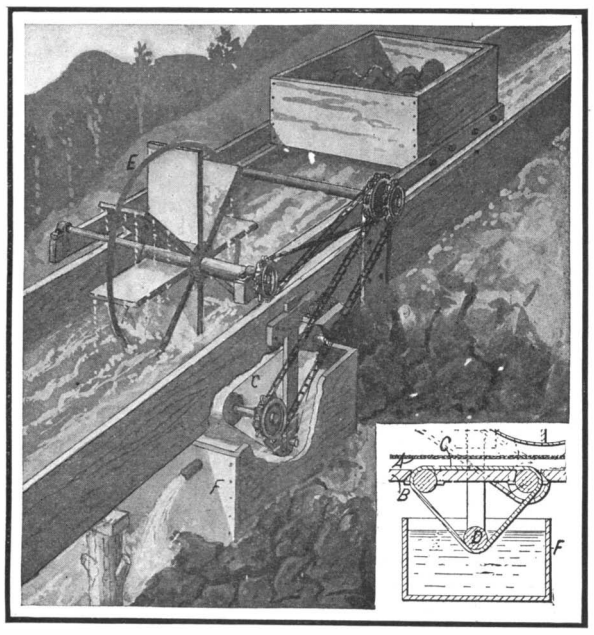
The Tornado Picked up a Caster from a Table, Unscrewed the Top, Took Off the Turntable, and Drove the Central Rod Through the Branch of a Tree.

THE WORK OF A NEBRASKA CYCLONE.

Patent Department

IMPROVED SLUICE BOX.

Sluice boxes as ordinarily constructed are provided with a false bottom of perforated material, and a true bottom beneath the false one with a covering of matting, or blanket material, to catch the fine gold, platinum, etc., that passes through the false bottom. The objection to this construction is that after a few hours

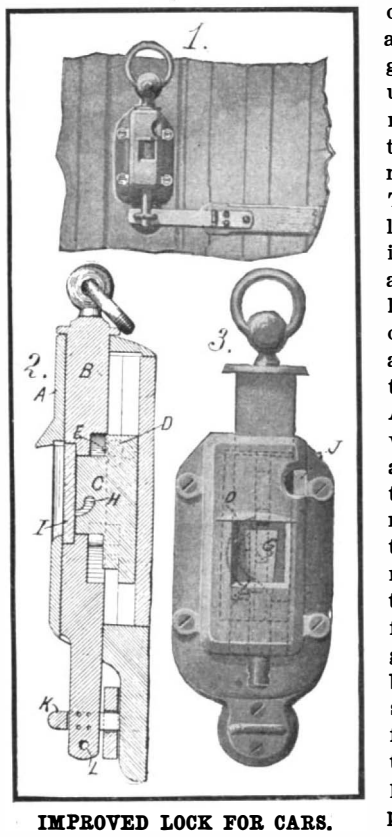


IMPROVED SLUICE BOX.

of running the material is filled up by the fine particles of metal and black sand, and will take no more until it has been cleaned out. To overcome this objection, the construction shown in the accompanying engraving has recently been invented. It consists in providing a traveling blanket or apron, which is constantly washed in a reservoir of water below the sluice box, so that it is kept clean. The power for driving this apron is taken from the water running in the flume. As shown in the engraving, the sluice box is provided with the usual perforated false bottom *A*, and below this with the true bottom *B*. The revolving apron above referred to is indicated at *C* running on a pair of rollers which project through the true bottom of the sluice box. Below the sluice box the apron passes around a third roller *D* in a box filled with water. The roller *D* is mounted in a pair of adjustable hangers, so as to keep the apron taut. In the flume above the sluice box a water wheel *E* is mounted to rotate. By means of suitable gearing, the power of the water wheel is transmitted to one of the rollers that carries the apron. The fine gold that passes through the false bottom is caught on the apron and carried thereby into the box *F*, and the water in this box washes the apron clean. The inventor of this improved sluice box is Mr. Neil Quigley, of Dawson, Yukon, Canada (Box 378).

IMPROVED LOCK FOR CARS.

An improved lock of the seal type has recently been invented, which is particularly adapted for use on cars. The lock is so arranged that a single seal may be used to secure a number of locks on the same car by means of a wire. The details of the lock are best shown in the cross-sectional view, Fig. 2. The lock consists of a casing *A*, in which a bolt *B* is mounted to slide vertically. A slide *C* is formed with a projection adapted to engage the bolt *B*. The mechanism is such that the bolt *B* cannot be raised until the slide *C* is drawn forward out of engagement with a ball *D*. This ball is seated in a recess formed partly in the slide *C*, and partly in a fixed part of the lock. The slide *C* is drawn forward by means of a key inserted in the arcuate recess *H*, and when it is drawn forward, the ball *D*, being prevented from following by a pin *E* in the bolt, is forced downward, depressing a semicircular retainer *F*. The lower point of this retainer passes behind a boss on the slide *C*. The seal consists of a brittle plate *I*, which is placed in a recess in the bolt. The seal can be placed in the bolt only when the latter is raised, as indicated in Fig. 3, it being then inserted through a slot in the side of the casing at the point *J*. With the seal in place the bolt is lowered, and the cam surface *G* on the slide *C* bears against the lower end of the curved retainer *F*, forcing the latter upward and seating the ball *D* in its locked position. The bolt can not then be raised until the seal is broken to give access to the keyhole *H*. The lower end of the bolt passes through the staple *K*, which is engaged by the hasp, and thus serves to secure the door in locked position. When it is desired to secure a number of locks by a single seal, a wire is run through the holes *L* of several bolts, and then if any one of the locks is sealed, the entire series will be secured. The lock can be cheaply manufactured, and contains no springs or small pins which are liable to break or wear. It can be used as a universal lock, each company having its own seal. The inventor of this lock is Mr. Kingman N. Cather, of Colorado Springs, Colo.



IMPROVED LOCK FOR CARS.

A Sanitary Wall Paper.

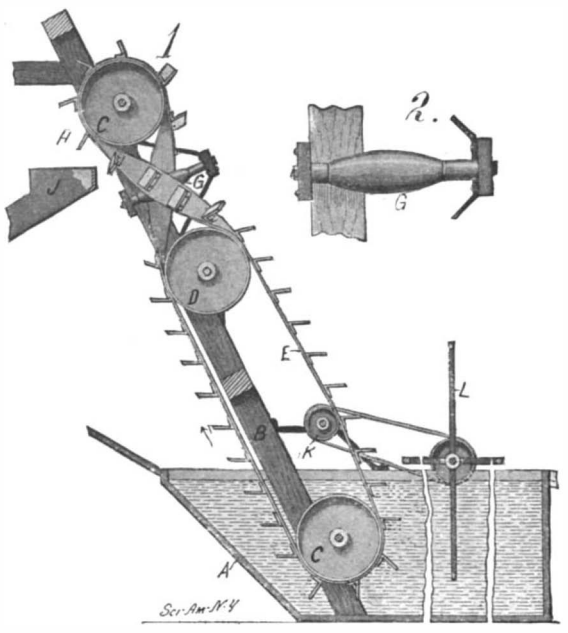
A new development in wall-paper manufacture has been perfected in England. The unsanitary character of ordinary wall paper is well known, since it offers a refuge for dust and germs, while it cannot be cleansed, and moreover frequently contains materials which in themselves are highly prejudicial to health. This latest invention, however, comprises a metallic wall paper—not a paper background with the metal effect produced by the use of metallic paint compositions, but in reality consisting of very thin sheets of metal, a little stouter than tinfoil. Consequently, they are absolutely non-absorbent, while at the same time having a smooth surface that can be dusted or even washed without any liability of becoming damaged thereby, nor does the material harbor vermin or germs. Any pattern, smooth, embossed, or stamped, can be secured, and indeed the artistic range is more extensive than with the ordinary material. The wall paper is manufactured by a patent electro-depositing process, the fabric being made in continuous lengths. It can if desired be obtained with a paper backing to the metal surface, in which case it is applied to the walls in the usual manner, or can be procured in the pure metallic state, adhesion to the walls in this case being effected by a special cement. The latter style is particularly adapted to damp walls, to which paper cannot be attached with any certainty of durability. Copper is preferably the base metal of this new fabric, but other metals can be combined therewith, giving most beautiful effects.

NON-REFILLABLE BOTTLE.

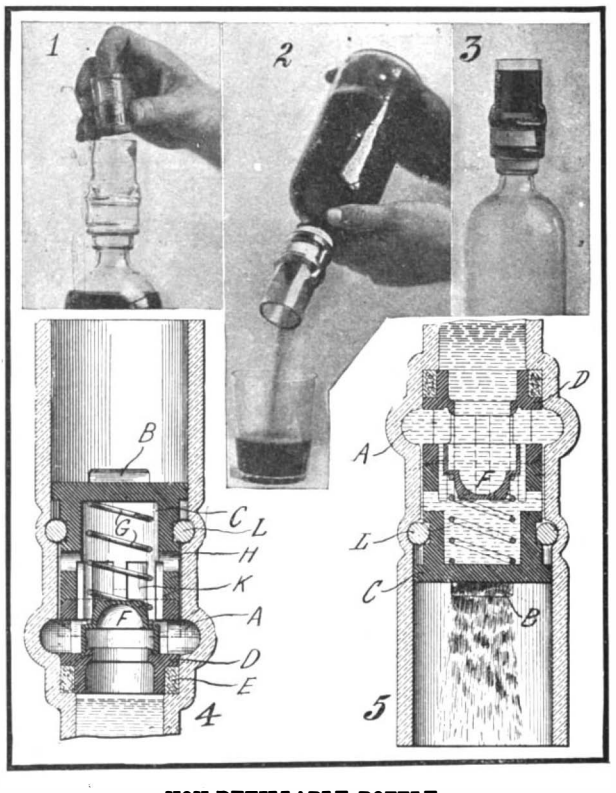
According to the statement of a prominent whisky manufacturer, ninety-nine per cent of the bottles sent out by his firm are refilled seven or eight times, or as often as the condition of the label will permit. The remaining one per cent represents the liquor sold to the family trade, and even these bottles are collected by junk men, and sold to saloon keepers to be refilled with inferior liquors. Under such conditions it is not surprising that there should be a great demand for a practical non-refillable bottle. One of the latest inventions along this line is illustrated in the accompanying engraving. The details of the valve mechanism are indicated in the sectional views, one of which shows the bottle inverted to permit the liquid to pour out. The neck of the bottle is blown with an annular recess *A*, from which a pair of opposite passages *B* lead upward to a point above the mechanism. Located in the neck is a tubular member consisting of two sections *C* and *D*, that are formed with tongues to hold them against relative rotation. The lower section *D* is fitted tightly into the neck of the bottle by means of a cork ring *E*. This section is provided with a valve seat adapted to be engaged by the valve *F*. The latter is pressed into engagement with the valve seat by a hair spring *G* of phosphor bronze. The upper section *C* is held in place by means of a split ring *L*, or any other of the well-known retaining devices. While the spring *K* is strong enough to hold the valve in contact with its seat, when the bottle is inverted the weight of the liquid on the valve is sufficient to compress the spring and open the valve, as indicated in Fig. 5. The liquid then pours out of the bottle by way of the annular recess *A* and passages *B*. Such of the liquid as enters the tube sections *C* pours out through the passages *H*. The bore of the section *C* is provided with a number of longitudinal grooves *K*, so as to permit the liquid to flow freely past the valve *F*. The spring *G* will permit the valve to open under the weight of a very small quantity of liquor, and hence it does not substantially impede the flow of the liquid. However, when the bottle is empty, the valve is closed by the spring, and as it cannot be reached by a wire, it is impossible to open it. The inventor of this improved non-refillable bottle is Mr. Valentine Sandberg, of 1845 East 7th Street, Brooklyn, N. Y.

ELEVATOR FOR RAISING ORE CONCENTRATES.

The accompanying engraving illustrates an elevator adapted for raising ore concentrates from washing tanks or separators, and discharging them at a point remote from the container. The illustration shows a sectional side elevation of the elevator. The separating tank is indicated at *A*. Mounted in the tank, near the inlet side, is a frame *B*, which carries a pair of rollers *C* one at each end. Below the upper roller *C* is a third roller *D*. A belt *E* runs over these rollers, and between the roller *D* and the upper roller *C* it is crossed, so that the rollers rotate in opposite directions. At the point where the two runs of the belt cross each other, a roller *G* is provided to separate them, and prevent them from injuring each other by frictional engagement. Secured to the belt at regular intervals is a series of carriers *H*, each carrier consisting of a flat plate projecting horizontally outward, and a small flange lying against the face of the belt. The carriers are attached to the belt by means of bolts or rivets passed through the flanges. In operation, as the carriers pick up the material from the tank *A*, after passing roller *D* they are twisted around and crossed over to the opposite side of the roller *C*. After passing over roller *C* they deliver the material into the hopper *J*. The carriers are preferably formed without side walls, to enable the water to drain out of the material as it is being elevated. The belt is driven by frictional contact with a drum *K*. Near the outlet end of the tank a reel is mounted, which is driven by belt connection with the drum *K*. The heavier material, which settles near the bottom of the tank *A*, is pushed by the reel arms *L* toward the elevator, while the lighter material near the top of the container is not acted upon by the reel, and passes with the liquid over the overflow. The inventor of this elevator is Mr. G. H. Davidson, of Morenci, Ariz. (Box 277).



ELEVATOR FOR RAISING ORE CONCENTRATES.



NON-REFILLABLE BOTTLE.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

ATTACHMENT FOR STABLE-BLANKETS.—C. A. Noble, Catskill, N. Y. The object of the invention is to provide an anti-slipping attachment for stable blankets. The rear bar is longer than the front, so that when the attachment is fastened to the blanket in use, then the hinges formed by the eyes are approximately at a level, as the front end of the blanket follows the curved neck of the animal and the members of the attachment are inclined forward, thus causing the blanket to properly fit the animal, at the same time preventing it from slipping to one side while in use.

DESK.—Van E. Kilpatrick, Yonkers, N. Y. The desk is such as used in schools. The object of the invention is to produce a desk which is adapted to be easily transformed into a drawing table; and further to provide the desk with an attachment facilitating the holding of the drawing instruments.

WATCHCASE.—J. M. Biggs, Glasgow, Ky. The invention is an improvement in watch cases, being in the nature of a calendar watch case adapted to be carried in a pocket, and having a special construction of relatively movable devices whereby the calendar will be a perpetual one, and may be shifted from time to time if necessary in order to serve the purpose of a pocket calendar.

FOLDING UMBRELLA.—J. F. Dolles, Chester, Ill. This umbrella is simple, light, and strong in construction, and can be folded in such a small compass that it can be conveniently placed in a pocket or in a suit case, satchel, or the like, or by means of a clip fastened to a person's clothing. It can be expeditiously unfolded and opened, and the handle serves as a receptacle for the folded body, rendering it possible for the umbrella to be folded and inclosed while wet without dampening any object or material with which it may be in contact. The umbrella has been in use for the past three months and is a perfect success in the operations specified.

Hardware.

BUCKLE.—R. London, New York, N. Y. The invention relates to buckles such as used on knee pants and other garments and articles. The object is to provide a buckle adapted to be conveniently and securely attached to the garment or article, and arranged to allow ready insertion of the strap and secure retention thereof in the buckle.

Heating and Lighting.

MINER'S LAMP.—A. Husson, Oshkosh, Wis. Mr. Husson's invention contemplates the avoidance of waste of fuel which obviously keeps the lamp in an unclean and greasy condition, which he does by making the conducting wire in two sections, one of the sections being fixed in, and closing, the inner end of the guide-tube arranged alongside the spout of the lamp, and the other section adjustable to this tube and adapted to project into the flame.

Household Utilities.

INVALID-BED WITH COMMODE ATTACHMENT.—W. C. Feely, New York, N. Y. One of the purposes in the invention is to provide a very simple construction of an invalid bed and commode attachment therefor, constituting a fixture relatively to the bed and having vertical and lateral adjustment, and wherein the body is provided with head and foot telescopic sections, the commode being located at the parting of the sections.

FINISH FOR STOVES.—Theresa Frye, Davenport, Iowa. To apply the composition, the stove should be at a moderate heat. It is not necessary to wash the stove, as the composition unites with and removes all grease. Neither is the use of a brush necessary. The composition, far from rusting, preserves the stove and keeps its surface hard and true. All particles of scale and loose rust should be first removed before applying the composition.

VESSEL-CLOSURE.—W. H. Prest, Webbwood, Ontario, Canada. The closure is particularly of use in connection with sealing jars and the like. The object is to provide means for permitting the escape of excess steam generated in the preparation of preserves and the like. Further, to provide a closure having an adjustable escape valve, which can be regulated to permit the escape of steam or other vapors from the jar at any desired pressure.

AUTOMATIC SUPPLY-COCK.—F. B. Easton, New York, N. Y. This cock automatically supplies tanks and other receptacles with a liquid when the liquid becomes exhausted or sinks below a predetermined level. The working parts are entirely inclosed, especially avoiding the leakage about the valve of the cock and the hissing sound usually attendant therewith when in operation. The valve is automatically seated in the pressure in the supply pipe and automatically opened against such pressure to refill the tank by a novel arrangement of elements.

Machines and Mechanical Devices.

PATTERN MECHANISM FOR STRAIGHT-KNITTING MACHINES.—J. Schutz, New York, N. Y. The invention pertains to knitting machines having two straight rows of needles arranged on opposite sides, and its object is to provide a machine arranged to automatically vary the relation of successive rows of stitches according to a predetermined design, for producing a fabric of a highly ornamental character.

SAW.—S. Rose, New Orleans, La. More particularly the invention relates to rotary saws used for felling trees. The object is to provide a rotary saw mounted upon a suitable transportable frame, and adapted to be operated manually or by a driving motor such as an explosive engine or the like. Another of the objects is to provide a rotary saw movably carried upon a transportable frame and arranged to be projected against a tree trunk.

PNEUMATIC PIANO-PLAYER.—C. E. Pryor, Binghamton, N. Y. In the present patent the invention is an improved supplemental adjustable abstract attached to the lifting rod interposed between the piano playing keys and the wippin or rocking lever forming part of the hammer-actuating mechanism. The adjustment can be made by any person without previous experience.

ROLLER-BEARING.—E. Moonen, 69 Rue de Balagny, Paris, France. The improvement has reference to roller bearings and similar anti-friction devices, and has for its object more particularly to prevent any relative displacement of the different parts in the transverse direction, to enable the races to be made in a single piece without any joint and finally of facilitating the assemblage of such devices.

JEWELER'S STAKING-TOOL.—L. Russell, Carthage, Ill. The invention in the present patent is especially adapted for use in holding the balance wheel firm and solid to the circular table, in order that the staff may be withdrawn or inserted in the wheel without destroying the balance of the wheel.

MACHINE FOR CLEANING INKING-ROLLERS.—C. Wagner, New York, N. Y. This machine is arranged to permit of conveniently and quickly placing the inking roller in position for cleaning the same, to thoroughly and quickly clean the inking roller of the ink and other undesirable matter, and to leave the peripheral surface of the roller in condition for properly receiving and applying the ink to the surface to be inked when the roller is used in the printing machine.

STOP-MOTION.—E. E. Taliaferro, Colorado Springs, Col. This application is a division of Mr. Taliaferro's pending application for a blacking machine. The invention relates to stop motions, devices for disconnecting driven parts from driving members, in such manner as to avoid breakage in case the movement of one or more of the driven parts is obstructed. The power is automatically shut off whenever a driven part is unduly obstructed in its movement.

Railways and Their Accessories.

ELECTRIC INDICATING SYSTEM FOR RAILWAYS.—H. G. Dorsey, Ithaca, N. Y. By this system the engineer or employee on one train may ascertain the presence of an obstruction such as an open switch, a broken rail, or a second train, if within a predetermined distance. The trainman not only ascertains the presence of an obstruction, but if it is a moving train, he finds the direction and speed it is running. The same principle may be employed for knowing from a station, the instant a train comes within predetermined distance from said station, the direction the train is coming and its rate of traveling.

GUARD-RAIL APPLIANCE FOR RAILROADS.—E. Muir, Springfield, Ill. One object here is to provide a filling block of novel form for spacing the guard rail from an adjacent track rail at and near each end of the guard rail, said filling blocks also serving as foot guards, and a further object is to provide a clamp which coacts with the improved filling block for retaining the block in operative position therein between a main track rail and a guard rail.

Pertaining to Vehicles.

METALLIC BELT.—H. L. Canne, Dingman Township, Pa. The invention relates to belts used for power transmission or for metallic overshoes for vehicle wheels, such, for instance, as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Canne. The object of the present improvement is to provide a metallic belt, simple, strong and durable in construction, and exceedingly flexible in every direction.

SPEED-CHANGING GEAR.—C. H. Lee, New York, N. Y. The improvement is especially adapted for use on motor vehicles. The object is to provide means whereby a driven shaft may be rotated in either direction or at any one of a plurality of different speeds by a driving shaft, whereby all of the low speed and reversing speed gear wheels may be permitted to remain stationary while the highest speed gear wheels are in operation.

Designs.

DESIGN FOR A BUTTON.—D. T. Klein, New York, N. Y. This ornamental design for a button comprises a button of round form in the center of which is the figure of a "Teddy" bear seated in profile view with arms extended.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

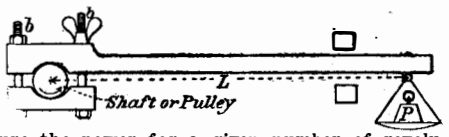
Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10819) J. R. says: In your issue of May 30, you explain electrified paper. You say the electricity was in the paper primarily, etc. It is rather put into the paper by moving it with friction. The electric force is converted motion. See Tyndall on correlation of forces. A. Electricity and electrification are two entirely distinct things. To quote Carhart's "University Physics," vol. 2, page 151, "Electrification is always the result of work done in charging with electricity. It is a form of potential energy, just as air under pressure and water elevated above the earth represent potential energy. But air and water on the one hand and electricity on the other are not energy, but only its v hicles. . . . Electricity, like matter and energy, appears to be indestructible. It may be put under pressure, or endowed with kinetic activity, but when its energy has been spent its quantity has suffered no diminution. None can be created and none destroyed." To this we add from Millikan's "Physics," page 247, "Electrification always consists in a separation of plus and minus charges which already exist in equal amounts within the bodies in which the electrification is developed." Electrification is converted energy, electricity is not. The electricity of rubbed paper was in the paper before it was rubbed, and the rubbing only separated the two kinds of electricity and produced a state of strain which we call electrification. Theories have changed greatly since Prof. Tyndall's day.

(10820) W. M. B. says: Please tell me through the columns of the Scientific American a rule for making the brake test for gasoline engines, so I may be able to find the actual power at any speed or size of pulley. A. The brake used for such a test as you desire consists primarily of a lever clamped either to the shaft or to a pulley of any size in such a manner that the friction induced between the surfaces of contact will tend to rotate the lever in the direction in which the shaft revolves, as shown in sketch. In order to measure the power for a given number of revolutions, a certain weight is placed in the scale pan on the end of the lever and the bolts b b tightened up till the friction induced balances the weight and the lever remains in its horizontal position while the revolutions of the shaft remain constant. For your purpose, a spring balance attached to any fixed point below the lever arm may conveniently be substituted for the scale pan. The horse-power is then determined as follows: Let W = work of shaft = power absorbed by brake per minute. P = unbalanced pressure or weight in pounds in scale pan (or recorded by spring balance). L = length of lever arm in feet from center of shaft. V = velocity in feet per minute of a point at distance L if arm were allowed to rotate at speed of shaft. N = number of revolutions per minute. Then $W = PV = 2\pi LNP$; and since $\text{H. P.} = \frac{PV}{33{,}000}$ $\therefore$ $\text{H. P.} = \frac{2\pi LNP}{33{,}000}$.



(10821) F. M. M. says: Is acid of 1,285 s. g. too strong to put in commercial storage batteries for automobiles? What would be the result if it were too strong? If a storage battery were charged backward, what would be the result? Would a permanent magnet voltmeter and ammeter indicate which way the current was going in battery? Would plates formed at factory indicate any voltage when assembled with acid ready for charging? A. The specific gravity of the electrolyte in a storage battery may vary from 1.180 to 1.250; 1.285 is too strong. It will sulphate the lead too much. If a storage battery were charged backward, the poles would be reversed. In some cells the negative plates are different from the positive in construction, and reversing the poles would not be well. It should not be done. A voltmeter and ammeter will indicate current perfectly. Most instruments are made in this way. The two principal makes of these instruments all have permanent magnets. Plates formed in the factory would show voltage when assembled. If not charged, the voltage would be small. Sloane's "Handy Book of Electricity" contains much information on these matters. We send it for $3.50.

NEW BOOKS, ETC.

Russia's Message. The True World Import of the Revolution. By William English Walling. New York: Doubleday, Page & Co., 1908. 8vo.; cloth; 476 pages; illustrated. Price, $3 net.

The movement in Russia may or may not be more than a scantly visible sign of a proclamation of social improvement which in many years will be a revolution on a basis of assured solidity, but the book shows that its people have a message. In forming a sound judgment on the many sides to this message the author did not view this great country entirely from afar. All the centers of influence outside of Russia were visited, and within, it is reassuring to find that there his sources of information are principally from active leaders on the scenes, and on a scale so vast as hardly to be looked for in interdicted districts. The times and the writer were both ripe for the review of the new European drama. In the divisional parts of the volume are found chapters that show a positive reflection from the inner ideas and spirit of the conflict, and coming direct from its most powerful leaders themselves. Those who speculate on the progress of humanity will here see one of its latest expositions largely in the Russian part of Russia, where just that amount of freedom is permitted as corresponds to the interests of the rulers. Portraits, habitations, occupations, and punishments are finely illustrated by photo-gravures.

A Pocket Handbook of Minerals. Designed for Use in the Field or Class-Room, with Little Reference to Chemical Tests. By G. Montague Butler, E.M. First edition. New York: John Wiley & Sons, Ltd., 1908. 12mo.; leather; 298 pages; illustrated. Price, $3.

The handbook will be found advantageous in its use of heavy face type for the most characteristic points of a paragraph, and the systematic arrangement by paragraphs. It gives all the details necessary to identify most of the minerals which students, collectors, and mining men encounter. The physical features of mineralogy are made prominent rather than the chemical, and through determinative tests rather than by details of debatable weight. Those who have had but little previous training on this subject will find the book very useful, and the glossary, index, explanation of tables and effective half-tone engravings to contribute largely to this result.

Earthquakes. An Introduction to Seismic Geology. By William Herbert Hobbs, Professor of Geology, University of Michigan. New York: D. Appleton & Co., 1907. 12mo.; cloth; 336 pages; illustrated. Price, $2 net.

The earthquake idea in fable, its point of view in Greek philosophy, its treatment by modern study, makes the evolution of its theory a remarkable introductory chapter in this latest investigation in seismology. We think the book is inspired to attract immediate and profound attention to the development of the new movement for earthquake research and on the lines fixed by this expert. America may claim at last her readiness to take a better stand in settling problems contingent and relative to the work of associating physicists and geologists in advancing the Science of the "New Seismology." The history of earthquakes and the study of earthquakes are fully illustrated with plates, diagrams, and engravings. All the chapters have the value of references at their ends, and the index is substantial.

The Wonder Book of Volcanoes and Earthquakes. By Prof. Edwin J. Houston, Ph.D. New York: Frederick A. Stokes Company. 12mo.; cloth; 369 pages; illustrated. Price, $1.50.

The title does not give any hint to the scientific value of the book, but the author has given a fair amount of attention in a few chapters to causes of earth convulsions, cataclysms and warnings, that permits the work to take a position in the field of recent contributions to the subject on more rising ground than would the mere interest created by his strong and accurate description of phenomena. The nebular hypothesis of La Place and Plato's account of Atlantis will be welcome to an owner of the volume. The illustrations are numerous and useful.

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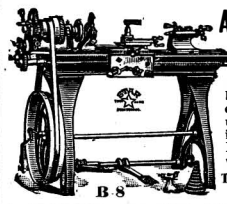

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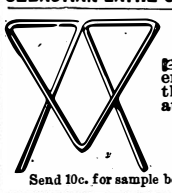

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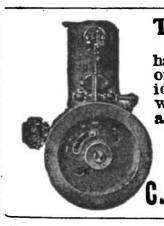

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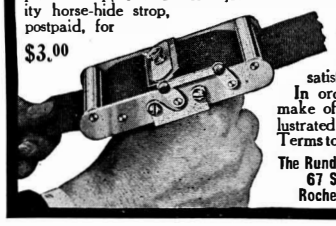

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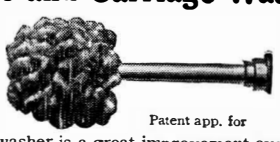

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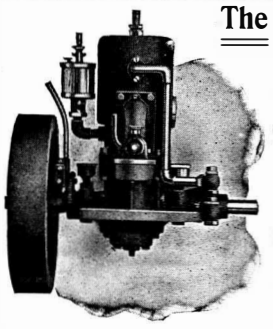

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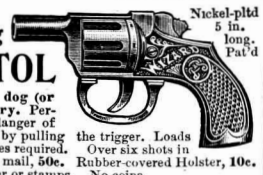

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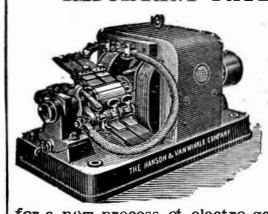

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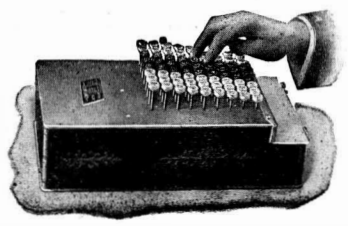

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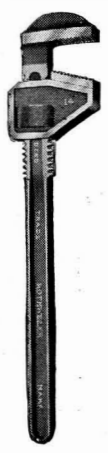

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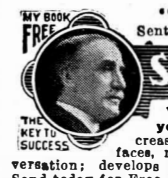

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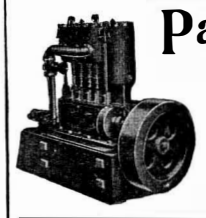

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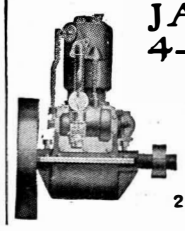

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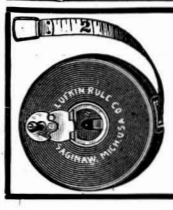

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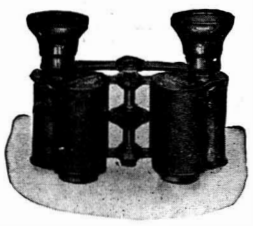

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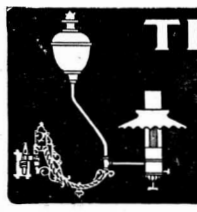

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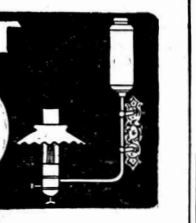

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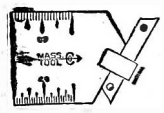

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